Agenda Item 5.4
For Information

Council

CNL(14)8

Report of the ICES Advisory Committee

10 NORTH ATLANTIC SALMON STOCKS — Advice May 2014

10.1 Introduction

10.1.1 Main tasks

At its 2013 Statutory Meeting, ICES resolved (C. Res. 2013/2/ACOM9) that the **Working Group on North Atlantic Salmon** [WGNAS] (chaired by: Ian Russell, UK) would meet at ICES HQ, 19–28 March 2014 to consider questions posed to ICES by the North Atlantic Salmon Conservation Organization (NASCO).
The sections of the report which provide the responses to the terms of reference are identified below.

			Section
a)	With respect to Atlantic salmon in the North Atlantic area:		Section 10.1
	i)	provide an overview of salmon catches and landings, including unreported catches by country, catch and release, and production of farmed and ranched Atlantic salmon in 2013[1];	10.1.5
	ii)	report on significant new or emerging threats to, or opportunities for, salmon conservation and management[2];	10.1.6
	iii)	provide a review of examples of successes and failures in wild salmon restoration and rehabilitation and develop a classification of activities which could be recommended under various conditions or threats to the persistence of populations[3];	10.1.7
	iv)	provide a review of the stock status categories currently used by the jurisdictions of NASCO, including within their Implementation Plans, and advise on common approaches that may be applicable throughout the NASCO area;	10.1.8
	v)	provide a compilation of tag releases by country in 2013;	10.1.10
	vi)	identify relevant data deficiencies, monitoring needs, and research requirements.	10.1.13
b)	With respect to Atlantic salmon in the Northeast Atlantic Commission area:		Section 10.2
	i)	describe the key events of the 2013 fisheries[4];	10.2.1
	ii)	review and report on the development of age-specific stock conservation limits;	10.1.6. & 10.2.1
	iii)	describe the status of the stocks;	10.2.1
	iv)	provide recommendations on how a targeted study of pelagic bycatch in relevant areas might be carried out with an assessment of the need for such a study considering the current understanding of pelagic bycatch impacts on Atlantic salmon populations[5];	10.1.11
	*In the event that NASCO informs ICES that the Framework of Indicators (FWI) indicates that re-assessment is required: **		
	v)	provide catch options or alternative management advice for 2014–2017, with an assessment of risks relative to the objective of exceeding stock conservation limits and advise on the implications of these options for stock rebuilding[6];	
	vi)	update the Framework of Indicators used to identify any significant change in the previously provided multi-annual management advice.	
c)	With respect to Atlantic salmon in the North American Commission area:		Section 10.3
	i)	describe the key events of the 2013 fisheries (including the fishery at St Pierre and Miquelon)[4];	10.3.1
	ii)	update age-specific stock conservation limits based on new information as available;	10.1.6 & 10.3.1
	iii)	describe the status of the stocks;	10.3.1
	*In the event that NASCO informs ICES that the Framework of Indicators (FWI) indicates that re-assessment is required: **		
	iv)	provide catch options or alternative management advice for 2014–2017 with an assessment of risks relative to the objective of exceeding stock conservation limits and advise on the implications of these options for stock rebuilding[6];	
	v)	update the Framework of Indicators used to identify any significant change in the previously provided multi-annual management advice.	

d)	With respect to Atlantic salmon in the West Greenland Commission area:		Section 10.4
	i)	describe the key events of the 2013 fisheries[4];	10.4.1
	ii)	describe the implications for the provision of catch advice of any new management objectives proposed for contributing stock complexes[7];	10.1.12
	iii)	Describe the status of the stocks[6];	10.4.1
	*In the event that NASCO informs ICES that the Framework of Indicators (FWI) indicates that re-assessment is required: **		
	iv)	provide catch options or alternative management advice for 2014–2016 with an assessment of risk relative to the objective of exceeding stock conservation limits and advise on the implications of these options for stock rebuilding[6];	
	v)	update the Framework of Indicators used to identify any significant change in the previously provided multi-annual management advice.	

Notes:
1. With regard to question a) i, for the estimates of unreported catch the information provided should, where possible, indicate the location of the unreported catch in the following categories: in-river; estuarine; and coastal. Numbers of salmon caught and released in recreational fisheries should be provided.
2. With regard to question a) ii, ICES is requested to include reports on any significant advances in understanding of the biology of Atlantic salmon that is pertinent to NASCO, including information on any new research into the migration and distribution of salmon at sea and the potential implications of climate change for salmon management.
3. With regards to question a) iii, NASCO is particularly interested in case studies highlighting successes and failures of various restoration efforts employed across the North Atlantic by all parties/jurisdictions and the metrics used for evaluating success or failure.
4. In the responses to questions b) i, c) i and d) i, ICES is asked to provide details of catch, gear, effort, composition and origin of the catch and rates of exploitation. For homewater fisheries, the information provided should indicate the location of the catch in the following categories: in-river; estuarine; and coastal. Information on any other sources of fishing mortality for salmon is also requested.
5. In response to question b) iv, if ICES concludes that there is a need for a study, provide an overview of the parameters and time frame that should be considered for such a study. Information reported under previous efforts and on migration corridors of post-smolts in the Northeast Atlantic developed under SALSEA–Merge should be taken into account.
6. In response to questions b) v, c) iv and d) iv, provide a detailed explanation and critical examination of any changes to the models used to provide catch advice and report on any developments in relation to incorporating environmental variables in these models.
7. The proposal specifically refers to NAC(13)4, tabled during the North American and West Greenland Commissions during the 2013 NASCO Annual Meeting.
8. In response to question d) ii, ICES is requested to provide a brief summary of the status of North American and North-East Atlantic salmon stocks. The detailed information on the status of these stocks should be provided in response to questions b) iii and c) iii.

*** The aim should be for NASCO to inform ICES by 31 January of the outcome of utilizing the FWI.**

The NEAC and West Greenland FWI assessments completed in January 2014 both indicated that no reassessment was necessary. There was therefore no requirement for ICES to address questions: b) v and vi, c) iv and v, or d) iv and v during the 2014 Working Group on North Atlantic Salmon (WGNAS) meeting.

In response to the terms of reference, WGNAS considered 41 Working Documents. A complete list of acronyms and abbreviations used in this report is provided in Annex 1. References cited are given in Annex 2.

10.1.2 Management framework for salmon in the North Atlantic

The advice generated by ICES is in response to terms of reference posed by the North Atlantic Salmon Conservation Organization (NASCO), pursuant to its role in international management of salmon. NASCO was set up in 1984 by international convention (the Convention for the Conservation of Salmon in the North Atlantic Ocean), with a responsibility for the conservation, restoration, enhancement, and rational management of wild salmon in the North Atlantic. Although sovereign states retain their role in the regulation of salmon fisheries for salmon originating in their own rivers, distant-water salmon fisheries, such as those at Greenland and Faroes, which take salmon originating in rivers of another party, are regulated by NASCO under the terms of the Convention. NASCO now has six parties that are signatories to the Convention, including the EU which represents its Member States.

NASCO discharges these responsibilities via the three Commission areas shown below:

10.1.3 Management objectives

NASCO has identified the primary management objective of the organization as:

"To contribute through consultation and cooperation to the conservation, restoration, enhancement and rational management of salmon stocks taking into account the best scientific advice available".

NASCO further stated that "the Agreement on the Adoption of a Precautionary Approach states that an objective for the management of salmon fisheries is to provide the diversity and abundance of salmon stocks", and NASCO's Standing Committee on the Precautionary Approach interpreted this as being "to maintain both the productive capacity and diversity of salmon stocks" (NASCO, 1998).

NASCO's Action Plan for Application of the Precautionary Approach (NASCO, 1998) provides an interpretation of how this is to be achieved:

- "Management measures should be aimed at maintaining all stocks above their conservation limits by the use of management targets".
- "Socio-economic factors could be taken into account in applying the precautionary approach to fisheries management issues".
- "The precautionary approach is an integrated approach that requires, *inter alia*, that stock rebuilding programmes (including as appropriate, habitat improvements, stock enhancement, and fishery management actions) be developed for stocks that are below conservation limits".

10.1.4 Reference points and application of precaution

Atlantic salmon has characteristics of short-lived fish stocks; mature abundance is sensitive to annual recruitment because there are only few age groups in the adult spawning stock. Incoming recruitment is often the main component of the fishable stock. For such fish stocks, the ICES maximum sustainable yield (MSY) approach is aimed at achieving a target escapement (MSY $B_{escapement}$, the amount of biomass left to spawn). No catch should be allowed unless this escapement can be achieved. The escapement level should be set so there is a low risk of future recruitment being impaired, similar to the basis for estimating B_{pa} in the precautionary approach. In short-lived stocks, where most of the annual surplus production is from recruitment (not growth), MSY $B_{escapement}$ and B_{pa} might be expected to be similar and B_{pa} is a reasonable initial estimate of MSY $B_{escapement}$.

ICES considers that to be consistent with the MSY and the precautionary approach, fisheries should only take place on salmon from rivers where stocks have been shown to be at full reproductive capacity. Furthermore, due to differences in status of individual stocks within stock complexes, mixed-stock fisheries present particular threats.

Conservation limits (CLs) for North Atlantic salmon stock complexes have been defined as the level of stock (number of spawners) that will achieve long-term average maximum sustainable yield. In many regions of North America, the CLs are calculated as the number of spawners required to fully seed the wetted area of the rivers. In some regions of Europe, pseudo stock–recruitment observations are used to calculate a hockey-stick relationship, with the inflection point defining the national CLs. In the remaining regions, the CLs are calculated as the number of spawners that will achieve long-term average MSY, as derived from the adult-to-adult stock and recruitment relationship (Ricker, 1975; ICES, 1993). NASCO has adopted the region-specific CLs (NASCO, 1998). These CLs are limit reference points (S_{lim}); having populations fall below these limits should be avoided with high probability.

Management targets have not yet been defined for all North Atlantic salmon stocks. When these have been defined they will play an important role in ICES advice.

Where there are no specific management objectives for the assessment of the status of stocks and advice on management of national components and geographical groupings of the stock complexes in the NEAC area, the following shall apply:

- ICES considers that if the lower bound of the 90% confidence interval of the current estimate of spawners is above the CL, then the stock is at full reproductive capacity (equivalent to a probability of at least 95% of meeting the CL).
- When the lower bound of the confidence interval is below the CL, but the midpoint is above, then ICES considers the stock to be at risk of suffering reduced reproductive capacity.
- Finally, when the midpoint is below the CL, ICES considers the stock to be suffering reduced reproductive capacity.

Therefore, stocks are regarded by ICES as being at full reproductive capacity only if they are above the MSY $B_{escapement}$ (or CLs).

For catch advice on the mixed-stock fishery at West Greenland (catching non-maturing 1SW fish from North America and non-maturing 1SW fish from Southern NEAC), NASCO has adopted a risk level of 75% (probability) of simultaneous attainment of management objectives in seven geographic regions (ICES, 2003) as part of an agreed management plan. NASCO uses the same approach for catch advice for the mixed-stock fishery affecting six geographic regions for the North American stock complex. ICES notes that the choice of a 75% risk (probability) for simultaneous attainment of six or seven stock units is approximately equivalent to a 95% probability of attainment for each individual unit.

NASCO has not formally agreed a management plan for the fishery at the Faroes. However, ICES has developed a risk-based framework for providing catch advice for fish exploited in this fishery (mainly non-maturing 1SW fish from NEAC countries). Catch advice is provided at both the stock complex and country level and catch options tables provide both individual probabilities and the probability of simultaneous attainment of proposed management objectives for both. ICES has recommended (ICES, 2013a) that management decisions should be based principally on a 95% probability of attainment of CLs in each stock complex / country individually. The simultaneous attainment probability may also be used as a guide, but managers should be aware that this will generally be quite low when large numbers of management units are used.

10.1.5 Catches of North Atlantic salmon

10.1.5.1 Nominal catches of salmon

Figure 10.1.5.1 displays reported total nominal catch of salmon in four North Atlantic regions from 1960 to 2013. Nominal catches of salmon reported for countries in the North Atlantic for 1960–2013 are given in Table 10.1.5.1. Catch statistics in the North Atlantic include fish farm escapees, and in some Northeast Atlantic countries also ranched fish.

Icelandic catches have traditionally been split into two separate categories, wild and ranched, reflecting the fact that Iceland has been the main North Atlantic country where large-scale ranching has been undertaken with the specific intention of harvesting all returns at the release site and with no prospect of wild spawning success. The release of smolts for commercial ranching purposes ceased in Iceland in 1998, but ranching for rod fisheries in two Icelandic rivers continued into 2013 (Table 10.1.5.1). Catches in Sweden have also now been split between wild and ranched categories over the entire time-series. The latter fish represent adult salmon which have originated from hatchery-reared smolts and which have been released under programmes to mitigate for hydropower development schemes. These fish are also exploited very heavily in homewaters and have no possibility of spawning naturally in the wild. While ranching does occur in some other countries, this is on a much smaller scale. Some of these operations are experimental and at others harvesting does not occur solely at the release site. The ranched component in these countries has therefore been included in the nominal catch.

Reported catches in tonnes for the three NASCO Commission Areas for 2004–2013 are provided below.

AREA	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
NEAC	1978	1998	1867	1409	1533	1163	1415	1419	1250	1107
NAC	164	142	140	114	162	129	156	183	127	141
WGC	15	15	22	25	26	26	40	28	33	47
Total	2157	2156	2029	1548	1721	1318	1610	1629	1411	1296

The provisional total nominal catch for 2013 was 1296 t, 115 t below the updated catch for 2012 (1411 t). The 2013 catch was the lowest in the time-series. Catches were at or below the previous ten-year averages in the majority of countries, except Greenland, Denmark, St Pierre et Miquelon (France), and Iceland.

ICES recognises that mixed-stock fisheries present particular threats to stock status. These fisheries predominantly operate in coastal areas and NASCO specifically requests that the nominal catches in homewater fisheries be partitioned according to whether the catch is taken in coastal, estuarine, or riverine areas. The 2013 nominal catch (in tonnes) was partitioned accordingly and is shown below for the NEAC and NAC Commission Areas. Figure 10.1.5.2 presents these data on a country-by-country basis. There is considerable variability in the distribution of the catch among individual countries. In most countries the majority of the catch is now taken in freshwater; the coastal catch has declined markedly.

	COAST		ESTUARY		RIVER		TOTAL
AREA	Weight	%	Weight	%	Weight	%	Weight
NEAC	342	31	76	7	689	62	1107
NAC	15	11	43	30	83	59	141

Coastal, estuarine, and riverine catch data aggregated by region are presented in Figure 10.1.5.3. In northern Europe, about half the catch has typically been taken in rivers and half in coastal waters (although there are no coastal fisheries in Iceland and Finland), with estuarine catches representing a negligible component of the catch in this area. There has been a steady reduction in the proportion of the catch taken in coastal waters over recent years. In southern Europe, catches in all fishery areas have declined dramatically over the period. While coastal fisheries have historically made up the largest component of the catch, these fisheries have declined the most, reflecting widespread measures to reduce exploitation in a number of countries. Since 2007, the majority of the catch in this area has been taken in freshwater.

In North America, the total catch over the period 2000–2013 has been relatively constant. The majority of the catch in this area has been taken in riverine fisheries; the catch in coastal fisheries has been relatively small in any year (15 t or less).

10.1.5.2 Unreported catches

The total unreported catch in NASCO areas in 2013 was estimated at 306 t; however, there was no estimate for Russia, Spain, or Saint Pierre and Miquelon. The unreported catch in the North East Atlantic Commission Area in 2013 was estimated at 272 t, and that for the West Greenland and North American commission areas at 10 t and 24 t, respectively. The following table shows unreported catch by NASCO commission areas in the last ten years:

AREA	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
NEAC	575	605	604	465	433	317	357	382	363	272
NAC	101	85	56	-	-	16	26	29	31	24
WGC	10	10	10	10	10	10	10	10	10	10

The 2013 unreported catch by country is provided in Table 10.1.5.2. It has not been possible to separate the unreported catch into that taken in coastal, estuarine, and riverine areas. Over recent years efforts have been made to reduce the level of unreported catch in a number of countries (e.g. through improved reporting procedures and the introduction of carcass tagging and logbook schemes).

10.1.5.3 Catch-and-release

The practice of catch-and-release (C&R) in rod fisheries has become increasingly common as a salmon management/conservation measure in light of the widespread decline in salmon abundance in the North Atlantic. In some areas of Canada and USA, C&R has been practised since 1984, and in more recent years it has also been widely used in many European countries, both as a result of statutory regulation and through voluntary practice.

The nominal catches do not include salmon that have been caught and released. Table 10.1.5.3 presents C&R information from 1991 to 2013 for countries that have records; C&R may also be practised in other countries while not being formally recorded. There are large differences in the percentage of the total rod catch that is released: in 2013 this ranged from 15% in Norway (this is a minimum figure, as statistics were collected on a voluntary basis) to 80% in UK (Scotland), reflecting varying management practices and angler attitudes among countries. C&R rates have typically been highest in Russia (average of 84% in the five years 2004 to 2008) and are believed to have remained at this level. However, there were no obligations to report C&R fish in Russia in 2009 and records since 2010 are incomplete. Within countries, the percentage of fish released has tended to increase over time. There is also evidence from some countries that larger MSW fish are released in higher proportions than smaller fish. Overall, more than 174 000 salmon were reported to have been caught-and-released around the North Atlantic in 2013.

10.1.5.4 Farming and sea ranching of Atlantic salmon

The provisional estimate of farmed Atlantic salmon production in the North Atlantic area for 2013 is 1429 kt. The production of farmed salmon in this area has been over one million tonnes since 2009. The 2013 total represents an 8% decrease from 2012, but a 15% increase on the previous five-year mean. Norway and UK (Scotland) continue to produce the majority of the farmed salmon in the North Atlantic (79% and 11%, respectively). Farmed salmon production in 2013 was above the previous five-year average in all North Atlantic salmon producing countries.

Worldwide production of farmed Atlantic salmon has been in excess of one million tonnes since 2002 and was over two million tonnes in 2012. It has previously been difficult to source reliable production figures for all countries outside the North Atlantic area and, for 2013, data for some countries were sourced from the FAO Fisheries and Aquaculture Department database in deriving a worldwide estimate. The total production in 2013 is provisionally estimated at around 1951 kt (Figure 10.1.5.4), a 6% decrease on 2012. Production outside the North Atlantic is estimated to have accounted for 27% of the total in 2013 (similar to 2012). Production outside the North Atlantic is dominated by Chile.

The worldwide production of farmed Atlantic salmon in 2013 was around 1500 times the reported nominal catch of Atlantic salmon in the North Atlantic.

The total harvest of ranched Atlantic salmon in countries bordering the North Atlantic in 2013 was 36 t, and taken in Iceland, Sweden and Ireland (Figure 10.1.5.5). No estimate of ranched salmon production was made in Norway in 2013 where such catches have been very low in recent years (< 1 t) and UK (N. Ireland) where the proportion of ranched fish was not assessed between 2008 and 2013 due to a lack of microtag returns.

10.1.6 Significant new or emerging threats to, or opportunities for, salmon conservation and management

10.1.6.1 Quantifying uncertainty in datasets using the “NUSAP” approach

WGNAS considered proposals in relation to an approach for communicating uncertainty of numbers in a more transparent way. The “Numeral, Unit, Spread, Assessment and Pedigree” (NUSAP) approach has been advocated to better represent unquantifiable uncertainties (Funtowicz and Ravetz, 1986; Van der Sluijs, 2005). The NUSAP approach provides a methodological framework to manage and communicate uncertainty and the quality of quantitative information. This extends the classic notational system for quantitative scientific information (usually provided as a number, a unit, and a standard deviation) with two additional qualifiers: expert judgment of the reliability (the assessment) and a multi-criteria characterization reflecting the origin and status of the information (the pedigree). It was suggested that the approach may be useful in communicating the outcome of fishery assessments and associated management advice; such an approach has been applied to an analysis of Western Baltic herring (Ulrich *et al*., 2010).
WGNAS noted that one of the proposed applications of the NUSAP approach was to enhance communication of the methods used by ICES to stakeholders and managers. This is laudable, but the approach is based on subjective evaluations and the outputs appeared likely to be quite detailed. It was therefore unclear how it might be implemented and how much it would assist stakeholders. It may, however, provide a better record of the provenance of data and assessment methods used by the Working Group and thereby enhance the information currently being compiled in the Stock Annex. WGNAS therefore concluded that they would be interested to hear of further development and application of the approach.

10.1.6.2.1 Interactions between wild and farmed salmon

Genetic introgression between wild and farmed escape salmon in the Magaguadavic River (Bay of Fundy, Canada) and other genetic studies in Canada

Recent studies supported by a Natural Sciences and Engineering Research Council of Canada grant, document the genetic temporal changes from 1980 to 2005 of the Magaguadavic River salmon population (Bay of Fundy, Canada), impacted by interbreeding with farmed escapees (Bourret *et al*., 2011). Overall, the results of this study indicate that farmed escapees have introgressed with wild Magaguadavic salmon, resulting in significant alteration of the genetic integrity of the native population, including possible loss of adaptation to conditions in the wild.

Another study of interest aimed at understanding the links between the environmental and genetic divergence of Atlantic salmon populations by using a large-scale landscape genomics approach with 5500 genome-wide single nucleotide polymorohisms (SNPs) across 54 North American populations and 49 environmental variables (Bourret *et al.*, 2013b). Multivariate landscape genetic analysis revealed strong associations of both genetic and environmental factors, with climate (temperature–precipitation) and geology being associated with adaptive and neutral genetic divergence, and should be considered as candidate loci involved in adaptation at the regional scale in Atlantic salmon.

Report on a new salmon trapping technique for farmed escapees in Norway

Recent evidence indicates that gene pools of wild salmon populations in a number of Norwegian rivers are gradually changing through introgression of genetic material from escaped farmed salmon. Genetic profiles were compared for salmon populations from 21 Norwegian rivers, developed from archival scale samples and contemporary scale and tissue samples, and changes were documented through analyses of microsatellites (Glover *et al.,* 2012) and SNPs (Glover *et al.*, 2013). In many rivers, considerable effort is invested to remove escaped farmed salmon from the spawning populations through various approaches, including netting, rod catches, and culling by divers. In 2013, the Resistance Board Weir trap, a portable salmon trap developed in North America, was tested in the River Etneelva, Norway. This is the first time the trap has been tested outside North America; the Norwegian trial was a collaboration between the Institute of Marine Research, management authorities, and the salmon farming industry.

The River Etneelva is subject to special protection in Norway, and is one of the largest salmon rivers on the west coast. The weir trap is based on floating panels, which prevent salmon from ascending and guide fish into a trap chamber. Altogether, 1154 wild salmon, 85 farm escapees, and 922 anadromous trout (*Salmo trutta*) were captured. Catch efficiency of the trap was estimated by recapture rates by anglers, and by counts of spawners performed by drift dives (snorkelling). Based on the two estimates, about 85% of ascending salmon were captured in the first year of operation, and 92% of ascending escaped farmed salmon were removed. The catch rate (excluding caught and released fish) by anglers was calculated at 26%. The conclusion from the first year of operation is that the trap works very well, can be considered a useful tool for generating precise data on the spawning run of wild salmonid populations, and an efficient method for removing farmed salmon from wild salmon populations.

10.1.6.3 Tracking and acoustic tagging studies in Canada

WGNAS reviewed the latest results of ongoing projects (led by the Atlantic Salmon Federation in collaboration with the Ocean Tracking Network, Miramichi Salmon Association, DFO, and others) to assess estuarine and marine survival of tagged Atlantic salmon released in rivers of the Gulf of St Lawrence. A total of 248 smolts (24 St Jean, 39 Cascapedia, 105 Miramichi, and 80 Restigouche) and 41 kelts (16 Miramichi and 25 Restigouche) were sonically tagged from rivers in Canada between April and June 2013. Of the 41 kelts, 11 from the Miramichi were also tagged with archival pop-up tags; these were set to release after four months.

The proportion of smolts detected (apparent survival) in 2013 from freshwater release points to the heads of tide, through the estuary and out of the Strait of Belle Isle, was somewhat lower than the previous years for the Cascapedia and Restigouche rivers and much lower for the Miramichi River; as in previous years only few St Jean fish were detected (Figure 10.1.6.3). Smolts and kelts exited the Strait of Belle Isle together during the last week of June and first week of July, similar to previous years. Analysis is proceeding to account for the variability in detection efficiency by receivers to better estimate survival rates and their variability.

The detector array across the Cabot Strait, between Cape Breton, Nova Scotia and Southwest Newfoundland was operational in 2012 and 2013, although few fish used this exit from the Gulf of St. Lawrence (one Cascapedia smolt in mid-June and one Miramichi kelt in late July, that had been tagged in spring 2012).

The satellite archival pop-up tags provided additional information in 2013, with information from seven of the tags that left the Miramichi River being recovered, and two of these transmitting information from the northern Labrador Sea when they "popped-off" at the start of September. Preliminary results show: evidence of predation on salmon kelts within the Gulf of St. Lawrence (likely by species such as a porbeagle shark); concentration of kelts south of Anticosti Island during the summer; and four fish leaving the Gulf of St Lawrence through the Strait of Belle Isle while the remainder stayed within the Gulf. Predation by large predatory fish has been noted previously for the Inner Bay of Fundy (Lacroix, 2014).

For the second year, a Wave Glider® was released into the Gulf of St Lawrence on the west coast of Prince Edward Island in mid-May 2013 to detect acoustically tagged salmon. The movements of the Wave Glider were controlled to pass through areas expected to contain tagged smolts and kelts on their migration through the Strait of Belle Isle. Detection of four of these salmon (kelts) did occur, as well as an acoustically tagged snow crab that was detected near the end of August. The Wave Glider trial ended off Cape Breton, Nova Scotia in early September.

In 2013, the Atlantic Salmon Federation also collaborated with the Miramichi Salmon Association and DFO in a study of striped bass and Atlantic salmon smolt interactions on the Miramichi River. Acoustic tags were used to document the spatial and temporal overlap of the two species, the passage of downstream migrating salmon smolts and the spawning migration into the lower Miramichi of the striped bass population of the Gulf of St. Lawrence. Significant losses of Miramichi smolts were detected in areas where striped bass were known to be spawning. Further work is ongoing, including diet and migrations of acoustically tagged striped bass.

ICES encourages the continuation of this tracking programme as information from it is expected to be useful in the assessment of marine mortality on North American salmon stocks. ICES also noted that these techniques are being proposed for similar research in other areas (Section 10.1.13).

10.1.6.4 Diseases and parasites

Testing for infectious salmon anemia virus (ISAv) and infectious pancreatic necrosis virus (IPNv) in mixed-stock aggregations of Atlantic salmon harvested along the coast of West Greenland, 2003–2011

Infectious salmon anemia virus (ISAv) and infectious pancreatic necrosis virus (IPNv) are fish pathogens that cause vascular disease and digestive disease, respectively, in Atlantic salmon, often with lethal effects. ISAv can cause mortality at any life stage, whereas IPNv usually causes mortality in juvenile stages (i.e. fingerling to post-smolt), but adults can be carriers of the disease and pass it to their offspring. The viruses are transmitted through a number of direct and indirect mechanisms, including contact with infected individuals and infected ambient water. Although naturally occurring, rates of ISAv and IPNv infection and epidemic outbreak are higher in and around aquaculture facilities due to the density at which fish are held. Wild individuals that come in contact with infected farmed fish (either by migrating past farms or through contact with infected escapees) can contract these viruses and pass them on to other wild individuals and populations. The diseases may therefore spread when individuals are in close proximity in the wild, such as when congregating at specific marine feeding areas.

Testing was carried out on 1284 Atlantic salmon sampled at West Greenland for ISAv in 2003–2007 and 2010–2011, and 358 Atlantic salmon in 2010 for IPNv. Samples from 2003–2007 were collected and processing was funded by NOAA Fisheries Service (USA). Samples from 2010–2011 were collected as part of SALSEA Greenland and processing was funded by NOAA Fisheries Service. The rate of ISAv infection was very low, 0.08%. A single North American origin Atlantic salmon was infected with a Scottish strain of HRPO (non-virulent ISA strain) suggesting that the transmission vector may have been another infected individual, possibly at the mixed-stock feeding grounds in the Labrador Sea or West Greenland. No fish tested positive for IPNv. These findings indicate that ISAv and IPNv are carried at very low to non-detectable levels in the wild Atlantic salmon population off the coast of West Greenland.

Update on red vent syndrome

Over recent years, there have been reports from a number of countries in the NEAC and NAC areas of salmon returning to rivers with swollen and/or bleeding vents. The condition, known as red vent syndrome (RVS or Anasakiasis), has been noted since 2005, and has been linked to the presence of a nematode worm, *Anisakis simplex* (Beck *et al*., 2008). This is a common parasite of marine fish and is also found in migratory species. However, while the larval nematode stages in fish are usually found spirally coiled on the mesenteries, internal organs, and less frequently in the somatic muscle of host fish, their presence in the muscle and connective tissue surrounding the vents of Atlantic salmon is unusual. The reason for their occurrence in the vents of migrating wild salmon, and whether this might be linked to possible environmental factors, or changes in the numbers of prey species (intermediate hosts of the parasite) or marine mammals (final hosts) remains unclear.

A number of regions within the NEAC area observed a notable increase in the incidence of salmon with RVS in 2007 (ICES, 2008a). Levels in the NEAC area were typically lower from 2008 (ICES, 2009a; ICES, 2010b; ICES, 2011b).

However, trapping records for rivers in UK (England & Wales) and France suggested that levels of RVS increased again in 2013, with the observed levels being the highest in the time-series for some of the monitored stocks.

There is no clear indication that RVS affects either the survival of the fish or their spawning success. Affected fish have been taken for use as broodstock in a number of countries, successfully stripped of their eggs, and these have developed normally in hatcheries. Recent results have also demonstrated that affected vents showed signs of progressive healing in freshwater, suggesting that the time when a fish is examined for RVS, relative to its period of in-river residence, is likely to influence perceptions about the prevalence of the condition. This is consistent with the lower incidence of RVS in fish sampled in tributaries or collected as broodstock compared with fish sampled in fish traps close to the head of tide.

Update on sea lice investigations in Norway

The surveillance programme for salmon lice infection on wild salmon smolts and sea trout at specific localities along the Norwegian coast continued in 2013 (Bjørn *et al.*, 2013), and for most areas sea lice infestation tended to be lower in the salmon smolt migration period than it had been in previous years.

In general, however, sea lice are still regarded as a serious problem for salmonids (Skilbrei *et al.*, 2013; Krkošek *et al.*, 2013) and especially sea trout (Bjørn *et al.*, 2013). Furthermore, a recent study has demonstrated that sea lice infections may alter life-history characteristics of salmon populations. Long-term studies with vaccination of smolts from the Dale and Vosso rivers have shown that fish infested with sea lice may delay their spawning migration and return as MSW fish instead of as grilse (Vollset *et al.*, 2014).

10.1.6.5 Quality norm for Norwegian salmon populations

In 2013 a management system – the Quality Norm for Wild Populations of Atlantic Salmon – was adopted by the Norwegian government (Anon., 2013). This system was based on an earlier proposal by the Norwegian Scientific Advisory Committee for Atlantic Salmon Management (Anon., 2011). Work is currently in progress to categorize the most important Norwegian salmon populations according to this system.

In this quality norm, the status of salmon stocks is evaluated in two dimensions (Figure 10.1.6.5); one dimension is the conservation limit and the harvest potential, and the other dimension is the genetic integrity of the stocks. In the conservation limit and harvest potential dimension both the attainment of the conservation limit (after harvest) and the potential for harvest in relation to a "normal" harvest potential is evaluated. The genetic integrity is evaluated in relation to species hybridization, genetic introgression from escaped farmed salmon, and altered selection as a result of selective harvest and/or human induced changes in the environment. The poorest classification in either of the dimensions determines the final classification of the stock.

10.1.6.6 Developments in setting conservation limits (CLs) in Canada (Québec) and Finland

Update of stock–recruitment models in Québec

Since the year 2000, management of Atlantic salmon in Québec has been based on biological reference points obtained from stock–recruitment models (Fontaine and Caron, 1999; Caron *et al.*, 1999). However, population dynamics have changed in Québec through the 1990s, as elsewhere in North America, following anthropogenic and environmental changes affecting both freshwater and marine survival of salmon (Friedland *et al.*, 2000). Moreover, since then, reliable data on stock abundance and characteristics have been collected in Québec (Cauchon, 2014) and stock–recruitment analyses have evolved with the development of new approaches (Parent and Rivot, 2012).

The Government of Québec has started to update its stock–recruitment model by using recent data and incorporating an up-to-date modelling approach. This initiative is part of a wider process aimed at developing a management plan for Atlantic salmon in Québec, and will allow updating of biological reference points so as to accurately represent the current status of salmon populations. The new Ricker model being developed includes 12 rivers from a broader geographical scale and with a wider range of production units than the previous model. At least 15 extra years were included in the new model, which now covers cohorts between 1972 and 2005. A Bayesian hierarchical approach was used, allowing uncertainty associated with population dynamics to be incorporated (Parent and Rivot, 2012). This approach also allowed habitat production units to be introduced as covariables in an integrated way, to better explain between-river variability and estimate biological reference points for other rivers in Québec that lack stock–recruitment data, but have known production units. It is anticipated that the new model will be implemented in 2015.

Progress with setting river-specific conservation limits in the River Teno/Tana (Finland/Norway)

In the River Teno/Tana (Finland/Norway), information has been collated to set CLs for most of the tributary systems and the main stem of the river following the Norwegian standard method (Hindar *et al*., 2007; Forseth *et al*., 2013). In addition, CLs have been updated for five Norwegian tributaries of the Teno system. A report will be published in 2014 describing the new CLs for this river system.

10.1.6.7 Recovery potential for Canadian populations designated as endangered or threatened

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) subdivided Canadian Atlantic salmon populations into 16 designatable units (DUs) based on genetic data and broad patterns in life history variation, environmental variables, and geographic separation (COSEWIC, 2010). Of the 16 DUs, one (Inner Bay of Fundy; DFO, 2008) had been listed as endangered since 2003 under Canada's federal Species at Risk Act (SARA). In 2010, COSEWIC assessed five other DUs as either "Endangered" (at risk of becoming extinct) or "Threatened" (at risk of becoming endangered), and four DUs as "Special Concern" (at risk of becoming threatened or endangered).

For the five DUs assessed as threatened or endangered, DFO has recently conducted Recovery Potential Assessments (RPAs) to provide scientific information and advice to meet the various requirements of the SARA listing process (DFO 2013a, 2013b, 2013c, 2014a, 2014b). Among the advice, each RPA contains information on population viability and recovery potential for populations with enough information to model population dynamics, as well as information on threats to persistence and recovery. The five DUs assessed were:

- **South Newfoundland (DU 4), Threatened** – The DU has a low probability of extinction. Under contemporary marine survival rates, the probability of meeting or exceeding the recovery target within the next fifteen years was improved by reducing recreational fishery mortality rates.
- **Anticosti (DU 9), Endangered** – The DU has a low probability of extinction. If survival and carrying capacity remain the same, the probability of meeting or exceeding the recovery target within the next fifteen years was improved by reducing recreational fishery mortality rates. The Anticosti rivers are rarely disturbed by human activities.
- **Eastern Cape Breton (DU 13), Endangered** – The probability of extinction for the two populations (considered to be two of the healthier populations) with enough information to model population dynamics is low if conditions in the future are similar to those in the recent past. Given the life history variability seen throughout the DU, the two populations included in the analyses are not considered to be representative of other populations in the DU. Identified threats to persistence included: illegal fishing; salmonid aquaculture; marine ecosystem changes; and diseases and parasites.
- **Southern Upland (DU 14), Endangered** – A region-wide comparison of juvenile density data indicated significant ongoing declines and provided evidence for river-specific extirpations. Modeling indicates that two of the larger populations remaining in the DU have a high probability of extirpation in the absence of human intervention or a change in survival rates for some other reason. Modeling also indicates that relatively small increases in either freshwater productivity or marine survival are expected to decrease extinction probabilities, although larger changes in marine survival are required to restore populations to levels above conservation requirements. Identified threats to persistence included: acidification; altered hydrology; invasive fish species; habitat fragmentation due to dams and culverts; illegal fishing and poaching; salmonid aquaculture; and marine ecosystem changes.
- **Outer Bay of Fundy (DU 16), Endangered** – The two rivers with enough information to model population dynamics are at risk of extinction. Increases in freshwater productivity are expected to result in an increase in population abundance and a decreased extinction probability, although increases in both freshwater productivity and marine survival are required to meet recovery targets with higher probabilities. Identified threats to persistence included: hydroelectric dams; illegal fishing activities; shifts in marine conditions; salmonid aquaculture; depressed population phenomenon; and disease and parasites.

10.1.6.8 Genetic stock identification

North American genetic database

A Natural Sciences and Engineering Research Council of Canada strategic grant enabled the development of a North American genetic database using standardized markers across Canada and USA. The database includes 9042 individuals from 152 sampling locations genotyped at 15 microsatellite loci standardized across three different laboratories. The database can be used for the analysis of mixed-stock fisheries and individual assignment to estimate the populations most impacted by these. The database also includes data from an expressed sequence tag (EST)-based medium-density SNP array which provides data on over 5000 SNPs for 20–25 individuals for each of 46 sampling locations (Bourret *et al*., 2013a). The SNP dataset is divided into neutral and potentially adaptive markers based on a genome scan analysis.

The first use of this database was to define regional groups. This was done by comparing microsatellites, neutral SNPs, and potentially adaptive SNPs in Québec. The seven regional genetic groups were confirmed for the provinces of Québec, New Brunswick, and Labrador, and analyses with SNP identified the same regional groups as previous analyses with microsatellites (Dionne *et al.*, 2008).

Composition of the mixed-stock fisheries at Greenland

A mixed-stock fishery analysis was carried out for the salmon fishery at Greenland using part of the new microsatellite baseline (Gauthier-Ouellet *et al.*, 2009). The entire North American microsatellite baseline was subsequently used in a preliminary analysis of the North American salmon taken in the 2011 West Greenland harvest (Bradbury, DFO Canada, pers. comm.). Average sample composition estimates obtained using Bayesian mixture analysis suggest that the majority of the catch consisted of fish originating from: Labrador (15%), Québec upper north shore (10%), Gaspé Peninsula (33%), and Maritimes (27%) populations. Other regions in North America were also detected, but at lower levels. It is proposed that samples for later years are analysed in the future.

Composition of the mixed-stock fisheries at Labrador

The stock composition and exploitation of Atlantic salmon in Labrador Aboriginal and subsistence fisheries was evaluated for 1772 individuals sampled between 2006 and 2011 at various locations; genetic mixture analysis and individual assignment with the entire microsatellite baseline was used (Bradbury *et al*., in press). For assignment purposes, eleven groups (Figure 10.1.6.8) were identified, for which assignment accuracy was >90%. Bayesian and maximum likelihood mixture analyses indicate that 85–98% of the harvest was of Labrador origin. Estimated exploitation rates were highest for Labrador salmon (4.3–9.4% per year) and generally < 1% for all other regions. Individual assignment of fishery samples indicates that non-local contributions to the fishery (e.g. Maritimes, Gaspé Peninsula) were rare and occurred primarily in southern Labrador. Genetic samples from 2012 and 2013 are currently being processed.

For the salmon sampled in the Labrador subsistence fisheries in 2013 (n = 544) scale analysis indicated that 79% were 1SW salmon, 16% were 2SW, and 5% were previously spawned salmon. The majority of the sampled salmon were river ages 3 to 6 years (99%) (modal age 4). No river age 1 and few river age 2 (1%) salmon were sampled, suggesting (as in previous years, 2006–2012) that very few salmon from the most southern stocks of North America (USA, Scotia–Fundy) are exploited in these fisheries.

ICES noted that this sampling programme provides biological characteristics of the harvest and the origin of the fish in the fishery, which are important parameters in the run–reconstruction model for North America and in the development of catch advice.

Composition of the mixed-stock fisheries at Saint-Pierre et Miquelon

The stock composition of Atlantic salmon caught in the mixed-stock fisheries at Saint-Pierre et Miquelon in 2013 was examined using the North American baseline described above. Samples were assigned to one of eleven regions in North America (Figure 10.1.6.8). This is the first time that samples from the fishery have been examined.

Samples were obtained from the fishery covering the period 17 May to 17 June 2013. Genetic analysis indicated that the sample (n = 71) contained 37% Gaspé Peninsula salmon (30 fish), 34% Newfoundland salmon (23 fish), 22% Maritimes salmon (13 fish), and 7% Upper North Shore Québec salmon (5 fish). The salmon sampled in 2013 were mostly two-sea-winter maiden salmon, with fewer one-sea-winter maiden salmon and only three repeat spawning salmon. Continued analysis of additional years will be informative of the characteristics of the salmon, age and size structure, origin of the fish, and the variation in the stock-specific characteristics of the catches.

ICES welcomed the analysis for genetic origin of samples of the catches at Saint-Pierre et Miquelon and recommends that sampling and supporting descriptions of the fisheries be continued and expanded (i.e. sample size, geographic coverage, tissue samples, seasonal distribution of the samples) in future years to improve the information on biological characteristics and stock origin of salmon harvested in these mixed-stock fisheries.

Composition of the catch in the mixed-stock fishery at Faroes

ICES received preliminary results from a genetic study of salmon scales collected in the Faroes salmon fishery in the 1980 and 1990s. This study involves scientists from UK (Cefas and Marine Scotland Science), Norway (NINA and IMR), and Faroes (MRI) and is funded by the NASCO IASRB and by UK, Norwegian, and Irish government departments. The aim of the study was to extract DNA from the historical scale samples and use the genetic stock assignment protocol developed during the SALSEA–Merge project (Gilbey *et al.,* pers. comm.) to estimate the historical stock composition of the catch.

Approximately 375 scale samples collected during each of the 1983/84 and 1984/85 commercial fisheries and the 1993/94 and 1994/95 research fisheries were selected for analysis. Initial results showed significant degradation of the DNA in some of the samples and reliable allele scorings could not be achieved for many of the microsatellites used. Improved DNA amplification was achieved for the later period using a modified polymerase chain reaction (PCR) process (Paulo Prodohl, pers. comm.), but this approach was less successful for the earlier period. As a result, the decision was made to limit the analysis to just the 1993/94 and 1994/95 samples.

Initial examination of the alleles at the SsaD486 microsatellite locus indicated that there were a number of samples with alleles normally only seen in North American fish. Further exclusion and conformation analyses also indicated that 101 of the samples (16%) were probably from salmon of North American origin. Further analysis will be undertaken to confirm the classification of these samples. The remaining fish have been assigned using a mixed-stock analysis performed separately for each month represented in the samples. Fish have been assigned to the hierarchical reporting units at four levels (1–4) as defined by the SALSEA–Merge project (Gilbey *et al.,* pers. comm.) The assignments at levels 1 and 3 were scaled to the average distribution of the catch during the fishing season when the commercial fishery operated in the 1980s. Initial results suggest that around two thirds of the European fish in the catch may have come from northern NEAC countries and one third from southern NEAC countries; this represents a significant change from the approximately 50:50 split currently used in the NEAC assessments. Further work will be undertaken to provide confidence limits for the estimation of catch composition and to determine how these results should be used in the NEAC assessment models.

10.1.6.9 Update on EU project ECOKNOWS – Embedding Atlantic salmon stock assessment at a broad ocean scale within an integrated Bayesian life-cycle modelling framework

Within the EU FP7 ECOKNOWS project, models are being developed that provide improvements to pre-fishery abundance (PFA) stock assessment models. A key development has been a Bayesian integrated life-cycle model that offers potential for future Atlantic salmon stock assessment on a broad ocean scale. The approach also paves the way toward harmonizing the stock assessment models used in the WGBAST (ICES Baltic salmon and trout assessment working group) and in WGNAS (Rivot *et al*., 2013).

The Bayesian integrated life-cycle modeling approach provides methodological improvements to the PFA forecasting models currently used by ICES:

- Existing biological and ecological information on Atlantic salmon demographics and population dynamics are first integrated into an age- and stage-based life-cycle model, which explicitly separates the freshwater (egg-to-smolt) and marine phases (i.e. smolt-to-return, which accounts for natural and fishing mortality of sequential fisheries along the migration routes), and incorporates the variability of life histories (i.e. river and sea ages) (Figure 10.1.6.9.1). This body of information forms the prior about the population dynamics, which is then updated through the model with assimilation of the available data.
- Both ecological processes and various sources of data are modelled in a probabilistic Bayesian rationale. Uncertainties are accounted for in both estimations and forecasting.
- The structure provides a framework for harmonizing the models and parameterization between different stock units, while maintaining the specificities and associated levels of detail in data assimilation.
- The approach also offers flexibility to improve the ecological realism of the model, as different hypotheses regarding the population dynamics can be assessed without changing the data assimilation scheme.

The model has been successfully applied to the stock complex from UK (Scotland East), the largest regional component of the southern NEAC stock complex (Massiot-Granier *et al.,* 2014), and different demographic hypotheses have been tested:

- Density-dependent effects in the freshwater phase can change estimates of trends in marine productivity, which may critically impact forecasts of returns and ecological interpretation of the changes in marine productivity.
- Two alternative hypotheses for the decline of return rates in 2SW fish are supported equally by the data: (1) a constant natural mortality rate after the PFA stage and an increase in the proportion maturing (current hypothesis in PFA models); (2) an increase in the natural mortality rate of 2SW fish relative to 1SW fish, and a constant proportion maturing. Changing from one hypothesis to the other may critically impact management advice, as applying a higher mortality rate for 2SW fish limits the expected impact, and thus the size of catch for the 2SW stock component.

A multi-regional extension of the integrated life-cycle model developed by Massiot-Granier *et al.* (2014) is under development. The model captures the joint dynamics of all the regional stock units considered by ICES for stock assessment in the Southern NEAC stock complex (Figure 10.1.6.9.1).

- Data available at the scale of eight stock units have been implemented as five units, applying the spatial variability of the post-smolt marine survival and the probability of maturing after the first winter at sea. The five units are: i) France; ii) UK (England & Wales); iii) Ireland and UK (N. Ireland); iv) UK (Scotland East and West); and v) Iceland Southwest.
- The hierarchical structure provides a tool for separating out signals in demographic traits at different spatial scales: i) a common trend shared by the 5 stock units and, ii) fluctuations specific to each stock unit.
- Both post smolt survival during the first months at sea (smolts to PFA stages) and the proportion of salmon returning to freshwater after two years at sea exhibit common decreasing trends in the stock units (Figure 10.1.6.9.2). Results support the hypothesis of a response of salmon populations to broad scale ecosystem changes, but changes specific to each of the five stock units still represent a significant part of the total variability (~40%), suggesting a strong influence of drivers acting at a more regional scale.

In association with ICES, the ECOKNOWS project will disseminate findings at the end of its tenure with a concluding symposium: *"Ecological basis of risk analysis for marine ecosystems"*, which is scheduled to be held 2–4 June 2014 in Porvoo, Finland.

10.1.7 Examples of successes and failures in wild salmon restoration and rehabilitation, and developing a classification of activities which could be recommended under various conditions or threats to the persistence of populations

The Working Group on the Effectiveness of Recovery Actions for Atlantic Salmon (WGERAAS) will have its second meeting 12–16 May 2014 at ICES in Copenhagen. A sub-group of WGERAAS met in Swansea, UK (England & Wales) on 18–19 June 2013 to further develop a database and approaches to data reporting. The database consists of all rivers from the HELCOM and NASCO river databases, combined with a system scoring the impact of a list of 10 stressors and 12 recovery actions on a river-by-river basis. A guide has been developed to assist in populating the database.

ICES has granted a request to extend the duration of WGERAAS by two years, taking the total duration to three years. WGERAAS received the following guidance from NASCO with regards to the TORs: "NASCO is particularly interested in case studies highlighting successes and failures of various restoration efforts employed across the North Atlantic by all parties/jurisdictions and the metrics used for evaluating success or failure". WGERAAS acknowledged the NASCO comment and such case studies will be a key focus of the upcoming meeting.

10.1.8 Stock status categories currently used by the jurisdictions of NASCO, including within their Implementation Plans, and advice on common approaches that may be applicable throughout the NASCO area

Introduction

The Atlantic salmon is widely distributed throughout the North Atlantic area. It is estimated that Atlantic salmon occur in around 2500 rivers across its geographical range. NASCO has developed a rivers database into which NASCO parties are obliged to enter details for each of their salmon rivers. The database is an important source of information on Atlantic salmon stocks and rivers. Most countries have provided data for this database, using the classification scheme described below, but NASCO has expressed concerns that this does not reflect the use of conservation limits (CLs) and management targets (MTs) in making management decisions, the approach agreed by NASCO.

The NASCO rivers database provides information on the status of the salmon stocks based on seven categories http://www.nasco.int/RiversDatabase.aspx. The database relates to salmon only and is applied to rivers primarily with reference to stock status.

The categories used in the NASCO rivers database (applied by all NASCO jurisdictions) are defined as:

> **Lost –** Rivers in which there is no natural or maintained stock of salmon but which are known to have contained salmon in the past.
> **Maintained –** Rivers in which there is no natural stock of salmon, which are known to have contained salmon in the past, but in which a salmon stock is now only maintained through human intervention.
> **Restored –** Rivers in which the natural stock of salmon is known to have been lost in the past but in which there is now a self-sustaining stock of salmon as a result of restoration efforts or natural recolonization.

Threatened with loss – Rivers in which there is a threat to the natural stock of salmon which would lead to loss of the stock unless the factor(s) causing the threat is (are) removed.
Not threatened with loss – Rivers in which the natural salmon stocks are not considered to be threatened with loss (as defined in the previous category).
Unknown – Rivers in which there is no information available as to whether or not it contains a salmon stock.
Not present but potential for salmon – Rivers in which it is believed there has never been a salmon stock but which it is believed could support salmon if, for example, natural barriers to migration were removed.

Many jurisdictions also implement other categorization systems, either through obligations under EU (e.g. EU Habitats Directive) or national legislation (e.g. Species at Risk Act, Canada, and Endangered Species Act USA). Categorizations are often provided with scientific advice for management purposes, which are closely linked to national management objectives requiring stocks to attain particular biological reference points (limit reference points and/or management targets). NASCO currently requires parties to report the current status of stocks relative to the reference points and how threatened and endangered stocks are identified within their national Iiplementation plans. These categories may require specific assessments or data or may only be applicable to rivers being assessed for compliance and not all rivers in a jurisdiction. A key difference in the various categories in use is whether they are applied at the stock level or at the species level.

Review of the stock status categories currently used by the jurisdictions of NASCO, including within their implementation plans

A range of stock status categories are used by different jurisdictions. Table 10.1.8.1 provides examples of various different stock categories in use for countries where categories are based on clear criteria. Countries with no specific national classification are excluded, although details of the broad approaches used in all NAC and NEAC countries were reviewed by ICES. The following provides a brief overview:

<u>Canada</u>

The abundance of Atlantic salmon relative to conservation limits (CLs) is used in Canada to assess stock status. Of the 1082 Canadian Atlantic salmon rivers tabulated in the NASCO database, annual assessments of returns and status relative to the CLs are available from between 65 and 75 major rivers.

In addition, reference points are being developed in Canada to reflect the application of the precautionary approach (DFO, 2006). The framework for this is shown in Figure 10.1.8.1.

<u>Ireland</u>

River- and age-specific conservation limits (CLs) have been derived and categorization of status of stocks for the provision of catch advice is based on a stock assessment for all 141 salmon-producing rivers in Ireland separately. This provides estimates of returns (counters, catches raised by exploitation rates) and status of stocks relative to the attainment of CLs. Advice on catch options is presented in relation to a 75% probability that this CL will be met, based on the average returns of the previous five years (Table 10.1.8.1).

<u>Norway</u>

Spawning targets have been calculated for 439 of the approximately 465 Norwegian rivers containing salmon. Attainment of spawning targets is assessed for about 200 river stocks; these account for about 98% of the total river catch of salmon in Norway. For advice on harvest, the management target was defined as being reached when the average probability of reaching the spawning target in the four previous years was more than 75%.

Assessment is now also based on the effects of human impacts which affect fish production and stock abundance and the capacity to produce a harvestable surplus. Norway established a salmon stock registry in 1993 and a new system was published in 2012. This classification system (Table 10.1.8.1) is based on a combination of both the number of fish in the populations and influences of different threats to the populations. The most influential factor in this new category system – the Quality Norm – is the modeled genetic integrity of the population (further details are provided in Section 10.1.6.5).

<u>Sweden</u>

As river-specific CLs are lacking for Swedish rivers, the stock status for each river is assessed using the abundance of parr. Salmon habitat quality is classed in three categories according to depth, water velocity, dominant substrate, slope, and stream-wetted width. For each category an expected abundance is calculated from electrofishing data from the

1980s, when the number of returning spawners was high. Data from each site each year are then compared to the expected value and expressed as a percentage. All sites in a river are pooled and the average (and 95% confidence limits) is calculated. Out of 23 rivers, data are collected and stock status determined annually for 17 of these, to enable their categorization (Table 10.1.8.1).

UK (England & Wales)

There are 80 river systems in UK (England & Wales) that regularly support salmon, although some of the stocks are very small and support minimal catches or are dominated by sea trout. CLs have been set for 64 principal salmon rivers. Annual compliance with the CL is estimated using egg deposition figures. These are derived from returning stock estimates, where such data are available. However, for rivers without traps or counters, egg deposition is typically based on estimates of the run size derived from rod catch and estimates of exploitation (with an appropriate adjustment for underreporting). In reviewing management options and regulations, the management objective is for a river's stock to meet or exceed its CL in at least four years out of five (i.e. >80% of the time) on average. Compliance against this management objective is assessed annually and stocks categorized into four groups (Table 10.1.8.1).

UK (N. Ireland)

River-specific CLs have been used to assess compliance and stock status for 12 of 15 rivers in UK (N. Ireland). Biological reference points, for individual catchments, have been established in both Department of Culture, Arts and Leisure (DCAL) and Loughs Agency jurisdictions. The status of stocks in the DCAL area is assessed relative to CLs while management targets (MTs) based on CLs are used to manage in real time within the Loughs Agency area. Specific categories have been derived to advise on the status of stocks (Table 10.1.8.1).

USA

The process for designating threatened and endangered stocks is specified in the US Endangered Species Act. In short, the National Marine Fisheries Service or US Fish and Wildlife Service conducts a review of the species status.

ICES stock status categories – used by all NASCO jurisdictions

ICES categorizes Atlantic salmon stock groups as being at: full reproductive capacity, at risk of suffering reduced reproductive capacity, or suffering reduced reproductive capacity (Table 1.10.8.1). This categorization is used for assessment and the provision of catch advice on management of national components and geographical groupings.

Review of other classification schemes used for categorizing species

In addition to the categorization of stocks, species classification requirements commonly also apply. Details of these schemes are provided in Table 10.1.8.2. The following text provides a brief overview:

Canada – COSEWIC

The Committee on the Status of Endangered Species in Canada (COSEWIC) identifies species at risk through processes put in place under the federal *Species at Risk Act* (SARA) and similar provincial laws (http://www.cosewic.gc.ca/eng/sct0/assessment_process_e.cfm#tbl2). A range of categories apply (Table 10.1.8.2).

Texel–Faial – Used for EU classification of species

The Texel–Faial classification is used by OSPAR and applied to regional assemblages rather than individual stocks: http://www.ospar.org/documents/dbase/decrecs/agreements/03-13e_Texel_Faial%20criteria.doc.

Annex V to the OSPAR Convention indicates that a package has been prepared to identify those species and habitats in need of protection, conservation, and where practical, restoration and/or surveillance or monitoring.

OSPAR nominated the Atlantic salmon for inclusion under this scheme on the basis of an evaluation of their status according to the Criteria for the Identification of Species and Habitats in need of Protection and their Method of Application (the Texel–Faial Criteria) (OSPAR, 2003), with particular reference to its global/regional importance, decline and sensitivity, with information also provided on threat.

A review of the status of Atlantic salmon was therefore carried out (OSPAR, 2010). Following this review, Atlantic salmon were classified by OSPAR as qualifying under the criteria: Global Importance, Local Importance, Sensitivity, Keystone species, and Decline. Atlantic salmon, however, did not qualify under the category of Rarity (Table 10.1.8.3).

European Union Habitats Directive – used for EU classification of species

The Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna) is used by the EU for the classification of species or habitats. Further details are available at: http://europa.eu.int/comm/environment/nature/nature_conservation/eu_nature_legislation/habitats_directive/index_en.htm.

If a species is included under this Directive, it requires measures to be taken by individual EU Member States to maintain or restore them to favourable conservation status in their natural range. While the objective of the EU is for nominated species to achieve "favourable status", the classification system pre-supposes that the species are in need of protection. The categories are described as Annexes (Table 10.1.8.2).

Convention on the Conservation of European Wildlife and Natural Habitats (The Bern Convention)

Further details on the Bern Convention are available at:
http://www.coe.int/t/e/cultural_co--operation/environment/nature_and_biological_diversity/Nature_protection/.

Atlantic salmon are included under Appendix/Annex III (freshwater only) (Table 10.1.8.2).

The World Conservation Union (IUCN) – (Red Data Books/Lists and Categories)

The IUCN Red Data Book is used to categorize species or geographic assemblages of species. A range of categories apply from 'extinct' to 'not evaluated' (Table 10.1.8.2).

Comparison of NASCO River Database categories with other classification systems

The primary differences in the classification systems illustrated above relate to whether they are applied at the stock level or at the species level. Both types appear to have some relevance to the categories currently in use in the NASCO Rivers Database, given that at very low stock status levels the species criteria listed above may provide a closer match with some of the NASCO categories. For comparison purposes, the NASCO categories are tabulated against both example stock categories (Table 10.1.8.4) and species categories (Table 10.1.8.5). It should be noted that many of the categorization schemes might best be viewed as continuous scales. As such, these 'tables' should not be interpreted as strict matrices implying direct alignment across rows; rather the 'tables' are intended to provide a basis for broad comparisons.

The NASCO categories broadly reflect these classifications but comparisons are more difficult at a detailed scale. The NASCO categories "maintained", "not present but potential", and "restored" are descriptive and do not appear to have a close parallel with the other species or river stock classifications generally in use. They clearly relate to special categories for stocks which have been or might be subject to special intervention, possibly including stocking. The NASCO categories "Threatened with loss" and "Not threatened with loss", while relating more directly to stock status, were also difficult to align directly with categories based on attainment of stock indicators because the terminology is imprecise and interpretation of these categories tends to encompass several categories in other systems.

NASCO has recommended the development of CLs for all stocks. However, these have not yet been developed by some jurisdictions, where alternative stock abundance indicators may be used in management. The implementation of any standardized classification scheme may also be difficult given the differences in the way national management advice is presented in different jurisdictions and it is unlikely that a standardized system for providing catch advice at the national level will be developed in the near future. Nevertheless, ICES considered that it might be possible to develop a classification more closely reflecting the generally applied categories used for describing stock status and providing management advice (i.e. CLs). A preliminary and tentative example of this is shown in the final two columns of Table 10.1.8.4. However, approaches would need to be developed to enable compliance with the classification criteria to be averaged over time periods and thus avoid the need for assessment and updating of the Rivers Database on an annual basis. In addition, some degree of expert judgement would also be required for stocks that do not currently have CLs.

10.1.9 Reports from expert groups relevant to North Atlantic salmon

WGRECORDS

The Working Group on the Science Requirements to Support Conservation, Restoration and Management of Diadromous Species (WGRECORDS) was established to provide a scientific forum in ICES for the coordination of work on diadromous species. The role of the group includes organizing expert groups, theme sessions, and symposia, and helping to deliver the ICES Science Plan.

WGRECORDS held an informal meeting in June 2013, during the NASCO Annual Meeting in Drogheda, Ireland. Discussions were held on the requirements for expert groups to address new and ongoing issues pertinent to diadromous species, including issues arising from the NASCO Annual Meeting. The annual meeting of WGRECORDS was held in September 2013, during the ICES Annual Science Conference in Reykjavik, Iceland. This meeting received reports from all the ICES expert groups working on diadromous species, and considered their progress and future requirements. Updates were also received from expert groups of particular relevance to North Atlantic salmon. The following are the ongoing, recently held, or proposed expert groups to be considered by ICES in 2014:

Ongoing – "The Working Group on Effectiveness of Recovery Actions for Atlantic Salmon (WGERAAS) – next meeting May 2014 (see Section 10.1.7).
Recent – Workshop on Sea Trout (WKTRUTTA). Chaired by Stig Pedersen, Denmark, and Nigel Milner, UK, met November 2013.
Proposed – The Workshop on Lampreys and Shads (WKLS), co-chaired by Pedro Raposo de Almeida, Portugal, and Eric Rochard, France, will be established and will meet in Lisbon, Portugal, for 3 days in October 2014.
Proposed – Planning Group on the Monitoring of Eel Quality: "Development of standardized and harmonized protocols for the estimation of eel quality".
Proposed – Joint Workshop of the Working Group on Eel and the Working Group on Biological Effects of Contaminants "Are contaminants in eels contributing to their decline?"
Proposed – A Working Group on Data-Poor Diadromous Fish (WGDAM), chaired by Erwin Winter, Netherlands, and Karen Wilson, United States.

Other issues arising from the WGRECORDS meeting which are of particular relevance to Atlantic salmon were:

- Inclusion of new proposals for Atlantic salmon data collection under the EU DC-MAP (see Section 10.1.13).
- Proposal for a theme session at the ICES ASC in 2014: "Analytical approaches to using telemetry data to assess marine survival of diadromous and other migratory fish species".

Report of NASCO's ad hoc West Greenland Committee Scientific Working Group

NASCO convened a group of scientific representatives, which were nominated by members of NASCO's West Greenland Commission (WGC), to develop a working paper in support of the upcoming NASCO WGC intersessional meeting. This meeting was held in London 14–15 April 2014 prior to the availability of formal ICES advice. The *ad hoc* West Greenland Committee Scientific Working Group was to compile available data on catches in the West Greenland salmon fishery from 1990 to 2013, including:

- Reported and unreported catches;
- The spatial and temporal breakdown of the catches;
- The origin of the catches by continent and at finer scales where possible (e.g. country or region of origin);
- Rates of exploitation on contributing stocks or stock complexes; and
- Any additional scientific data related to the fishery.

The *ad hoc* West Greenland Committee Scientific Working Group presented their working paper to ICES for consideration and review. ICES supported the working paper and considered it an accurate representation of historical and current data related to the Greenland fishery.

10.1.10 Tag releases by country in 2013

Data on releases of tagged, fin-clipped, and otherwise marked salmon in 2013 were provided by ICES and are compiled as a separate report (ICES, 2014a). A summary of tag releases is provided in Table 10.1.10.1.

10.1.11 Recommendations on how a targeted study of pelagic bycatch in relevant areas might be carried out with an assessment of the need for such a study considering the current understanding of pelagic bycatch impacts on Atlantic salmon

NASCO further elaborated the question in a note: "In response to question 2.4, if ICES concludes that there is a need for a study, provide an overview of the parameters and time frame that should be considered for such a study. Information reported under previous efforts and on migration corridors of post-smolts in the Northeast Atlantic developed under SALSEA–Merge should be taken into account."

ICES discussed the bycatch issue based on previous work undertaken by the Study Group on Bycatch of Salmon (SGBYSAL), reported by ICES (ICES, 2004a, 2005a), and in light of other information made available to WGNAS in 2014.

The background for the SGBYSAL study group was the observed large number of post-smolts taken together with catches of mackerel in Norwegian research surveys in the Norwegian Sea (June–August). These research surveys were targeted at salmon post-smolts, but overlapped in time and space with commercial pelagic fisheries. These observations gave rise to concerns that the large commercial fisheries in these areas, particularly for mackerel, might heavily intercept the post-smolt cohorts moving northwards during the summer months. However, Russian observers on-board commercial mackerel trawlers, and in separate research surveys, detected only negligible numbers of post-smolts in screened catches. This resulted in a very large discrepancy in the estimates of post-smolts taken as bycatch if the observed ratios of post-smolts to mackerel catches were scaled up to the total commercial mackerel catch in these areas (from 60 to over 1 million post-smolts taken as bycatch).

SGBYSAL (ICES, 2005a) recommended that catch ratios should not be extrapolated from Norwegian scientific salmon surveys to the entire pelagic fishery due to the absence of comparable efficiency estimates and the considerable differences in design and operation of the research survey and commercial trawls. It was considered, at the time, that the most reliable data for the purposes of extrapolation were those derived from the Russian research surveys that had taken place on the same spatial–temporal scale as the pelagic fishery and from the screening of commercial catches. It was further recommended that results from screening of pelagic survey catches should only be used when both the gear used and the fishery were similar to the commercial fishery. Thus, screening of the catches on-board commercial fishing vessels in relevant pelagic fisheries was considered to be the primary method of producing data for bycatch estimation.

SGBYSAL also considered that catches from other research surveys should continue to be screened for salmon, as this would add to overall knowledge about the temporal and spatial distribution of salmon at sea. In addition, it was recommended that further investigations into salmon marine ecology were required, in particular in relation to the distribution of salmon in time and space, in order to allow a better assessment of the potential overlap between salmon and pelagic fisheries. Any further directed research should also include investigation of the migration routes of salmon post-smolts from the coastline of the Northeast Atlantic countries into the shelf areas and onward into the northern summer feeding areas for post-smolt and adult salmon. In particular, surveys in more southerly areas should be undertaken in weeks 20–23 (mid-May to early June) while the northern areas should be covered in weeks 30–34 (late July to late August). Finally, SGBYSAL recommended that a questionnaire survey directed at the processing plants dealing with mackerel, herring, and horse mackerel should be considered to establish whether salmon have been observed during processing.

WGNAS (ICES, 2005b) endorsed the recommendations from SGBYSAL. Furthermore, they reiterated that direct on-board observation of pelagic catches was the most reliable method of bycatch estimation. Despite the difficulty in obtaining precise estimates of bycatch, ICES noted that the latest available upper estimate of potential salmon post-smolt bycatch in the mackerel fishery (154 482) represented approximately 5% of the estimated combined PFA for the NEAC stock complexes (10-year average PFA approximately 3.4 million) in the most recent assessment at the time.

Although SGBYSAL did not meet after 2005, further information was available in 2005 and 2006 on bycatches in pelagic research surveys and from screening of commercial catches. These data were consistent with earlier findings and WGNAS (ICES, 2006) continued to consider that the previous findings remained valid, i.e. that there were relatively low impacts of salmon bycatches in pelagic fisheries on PFA or returns to homewaters. However, these available new records remained insufficient to allow a detailed assessment of the effect of non-targeted fisheries on salmon abundance (the absence of disaggregated catch data, in both time and space, for pelagic fisheries also remained a key constraint). ICES (2006) recommended that future estimates should be refined, if possible, with annual estimates based on observer-based screening of catches.

Since this time, there have been further developments and new information has become available. More knowledge has been gained about post-smolt and salmon distribution and migration, mainly through the studies conducted during the SALSEA–Merge project. Figure 10.1.11.1 provides capture rates for post-smolts derived from this project and earlier captures from research surveys, indicating the distribution of some post-smolts along the shelf edge to the north west of the British Isles and, following migration further north, their subsequent widespread capture in the Norwegian Sea, with higher concentrations towards the eastern areas. Further information on bycatch has also been provided to WGNAS from screening of catches and landings, primarily by Iceland, and from the recent International Ecosystem Summer Survey of the Nordic Seas (IESSNS).

Bycatch of salmon in the Icelandic herring and mackerel fisheries was studied both by screening of landings and by screening of catches on-board fishing vessels, conducted by inspectors from the Icelandic Fisheries Directorate. The screening of landings only occurred when crew members indicated that some salmon bycatch had occurred, so these do not represent an unbiased sample of the whole landings. The number of landings / catches screened and the numbers of salmon detected during the period from 2010 to 2013 are shown in Table 10.1.11.1 (landings) and Table 10.1.11.2 (catches). The bycatch rates of salmon vary somewhat among years, but are mostly larger in screened landings (average 5.4 salmon per 1000 t catch; range 4.7–6.2 salmon per 1000 t) than in screened catches (average 2.1 salmon per 1000 t catch; range 0–5.5 salmon per 1000 t), likely reflecting the bias noted previously. Similar levels of bycatch were reported for Faroese fisheries in 2011 (ICES, 2012a). In this instance, the screening of 33 315 t of mackerel taken in pelagic pairtrawls occurred at land-based freezing plants and resulted in a bycatch rate of 2.4 salmon per 1000 t catch. In this screening programme, salmon were only reported from catches taken in May and June. Icelandic mackerel catches have constituted about 150 000 t in recent years and, assuming the salmon bycatch rates recorded in the screening are representative of the fishery as a whole, this would give a total salmon bycatch in the range of 300–800 individuals for this fishery. This represents 0.01 to 0.03% of the total estimated PFA of NEAC salmon (average total PFA for both maturing and non-maturing fish for the last five years). The catch composition of the Icelandic samples (Table 10.1.11.3) shows that salmon of length 20–50 cm made up 15% of the catch, salmon of length 50–70 cm made up 69% of the catch, and salmon of length 70–100 cm made up 16% of the salmon caught.

Bycatches of salmon taken in the IESSNS surveys in the period 2010–2013 were also presented to WGNAS (Figure 10.1.11.2). All vessels taking part in this survey have been using a specially designed pelagic trawl, fishing in the upper 30 m and in a standardized way, allowing the catches to be used quantitatively. The catches taken in these surveys are also carefully screened, so the certainty of the salmon bycatch count is very high, and all salmon are weighed, measured, and frozen for further analysis. These pelagic surveys, mainly targeting mackerel, cover large parts of the Norwegian Sea and Icelandic and Faroese waters (e.g. see Figure 10.1.11.3 for the survey area covered in 2012). However, despite this wide coverage, the bycatch of salmon mostly occurred in the eastern parts of the Norwegian Sea, as indicated by Figure 10.1.11.2. The salmon catch in the survey was low, but so were the total survey catches (Table 10.1.11.4), since the IESSNS sampling trawl is smaller than commercial trawls and the haul duration is only 15 minutes. However, when these rates are extrapolated to provide estimates of salmon per 1000 t of catch (comparable to the reported Icelandic values), the IESSNS bycatch rates are, on average, 20 to 50 times higher than those recorded from the commercial Icelandic fisheries (average of 103 salmon per 1000 t of catch; Table 10.1.11.4).

The pelagic fisheries in the Norwegian Sea and in the areas around Iceland and along the Greenlandic east coast have changed in recent years. Catches of Norwegian spring-spawning herring have declined in the last few years (ICES, 2013b). However, catch and survey data indicate that the mackerel stock has expanded north-westwards during spawning and in the summer feeding migration. This distributional change is likely a reflection of increased stock size coupled with changes in the physical environment and in the zooplankton concentration and distribution (ICES, 2013b). A northern expansion has been indicated by the recent summer surveys in the Nordic seas (IESSNS), while a westward expansion in the summer distribution of adult mackerel has also been observed in the Nordic Seas since 2007, as far west as southeast Greenlandic waters. Catches in ICES Subareas I, II, V, and XIV have increased markedly in recent years (Figure 10.1.11.4), with significant catches taken in Icelandic and Faroese waters, areas where almost no catches were reported prior to 2008 (ICES, 2013b). In 2012, mackerel catches in this area constituted approximately half of the total reported catches for the whole Northeast Atlantic. Catches from Greenland were reported for the first time in 2011, and increased in 2012. The distributions of mackerel catches for 2012 in quarters 2 and 3 are provided in Figure 10.1.11.5 and indicate some potential overlap with the distribution of post-smolt salmon – see Figures 10.1.11.1 and 10.1.11.2.

The latest information highlights ongoing uncertainty on the salmon bycatch question, although the issues remain very similar to those previously addressed by SGBYSAL and WGNAS. The latest bycatch estimates from the recent Icelandic and Faroese screening programmes suggest relatively low levels of bycatch in the mackerel catches and this is consistent with the previous views of ICES. Such assessment procedures, based on direct screening of the commercial catches, have previously been considered to provide the most reliable data for extrapolation purposes and this remains the case. ICES noted the markedly higher salmon bycatch rates recorded in the IESSNS surveys, but it is unclear how representative these might be of the bycatch in the commercial fishery given differences in the design and operation of the gears used. In any event, the capture rates remain low relative to the estimates of total NEAC PFA (< 2%). ICES further noted that while there was overlap between the areas known to be frequented by salmon and the areas where the pelagic fisheries were prosecuted, there were also apparent differences in the areas where the highest salmon and mackerel catches occurred, with the former tending to occur in more easterly parts of the Norwegian Sea. Nonetheless, the catches in these pelagic fisheries have increased and substantial uncertainties remain as to the extent to which the migration routes of post-smolt and adult salmon might overlap in time and space with these pelagic fisheries.

Given that estimates of the bycatch of salmon in the total pelagic fisheries are highly uncertain, ICES considers it would be informative to increase efforts to obtain reliable estimates of the bycatch of salmon. ICES, therefore, recommends the following:

- Collate all available information on post-smolt and salmon marine distribution, particularly from the SALSEA–Merge project.
- Collate information of possible interceptive pelagic fisheries operating in the identified migration routes and feeding areas of Atlantic salmon. This would require close cooperation with scientists working on pelagic fish assessments in the relevant areas and provision of disaggregated catch data in time and space which overlap areas known to have high densities of post-smolts or adults.
- Review pelagic fisheries, identifying important factors such as gear type and deployment, effort, and time of fishing in relation to known distribution of post-smolt and salmon in space and time, and investigate ways to intercalibrate survey trawls with commercial trawls.
- Carry out comprehensive catch screening on commercial vessels fishing in areas with known high densities of salmon post-smolts or adults. This would require significant resources and would need to be a well coordinated and well-funded programme.
- Integrate information and model consequences for productivity for salmon from different regions of Europe and America.

This might be approached as a phased investigation with the first elements possibly carried out by a combined Salmon/Pelagic Workshop or Study Group. The major element (catch screening) would likely require some preparation and agreement between NASCO parties and could be conducted as a joint collaborative exercise with cooperation from the pelagic fishing industry.

10.1.12 Implications for the provision of catch advice of any new management objectives proposed for contributing stock complexes

The reference points for provision of catch advice for West Greenland are the CLs of 2SW salmon from six regions in North America and the MSW CL from the southern European stock complex. NASCO has adopted these region-specific CLs as limit reference points with the understanding that having populations fall below these limits should be avoided with high probability. CLs for the West Greenland fishery for North America are limited to 2SW salmon and southern European stocks are limited to MSW fish because fish at West Greenland are primarily (>90%) 1SW non-maturing salmon destined to mature as either 2SW or 3SW salmon.

Alternative management objectives to the CLs were first proposed for the Scotia–Fundy and USA stock complexes in 2002, roughly at the same time that the risk analysis framework for providing catch advice at Greenland was developed and in response to strongly divergent trends in status of stocks between northern and southern regions of North America (ICES, 2002). Managers were concerned that the potential fishery at Greenland could be constrained by the status of the weakest stocks with no hope of meeting their CLs even if production from the northern areas became very high and in excess of CLs. Considering the differences in stock status among the regions, ICES (2002) proposed that fishery managers attempt to meet the CLs simultaneously in the four productive northern regions of North America (Labrador, Newfoundland, Québec, and Gulf) while defining and managing to meet stock rebuilding objectives for the two southern regions (Scotia–Fundy and USA). A rebuilding objective was agreed for each region consisting of a 25% increase in 2SW returns relative to the average returns for the period 1992 to 1996.

In the years since these management objectives were agreed, the estimated returns of 2SW salmon to Scotia–Fundy have remained relatively stable and low, in the range of 10 000 to less than 5000 fish during 1997 to 2012 (Figure 10.1.12.1). The returns have represented less than 20% of the 2SW CL and less than 50% of the management objective. This contrasts with the returns of 2SW salmon to the USA which were often at or above 50% of the management objective and in 2011 exceeded the objective (Figure 10.1.12.1). The USA 2SW returns have never exceeded more than 21% of the 2SW CL, but have been much closer to the management objective than Scotia–Fundy (Figure 10.1.12.1). ICES has provided catch advice considering these rebuilding objectives since 2002. However, ICES (2012c) also noted that to be consistent with achieving maximum sustainable yield and the precautionary approach, the overarching goal should be for fisheries to only take place on salmon stocks that have been shown to be at full reproductive capacity, and that CLs are limit reference points and having populations fall below these limits should be avoided with high probability.

Proposed revised management objective for USA

At the Thirtieth Annual Meeting of NASCO, the USA proposed a new management objective for the USA stock complex for the provision of catch advice at Greenland (NASCO, 2013). The previous management objective (ICES, 2004b) was viewed as a rebuilding objective and was established in light of the extremely depleted state of the endangered USA populations. It was indicated that this management objective is inconsistent with NASCO's Agreements, Action Plans, and Guidelines (NASCO, 1998, 1999, 2009) as well as interim recovery criteria for USA stocks protected by the Endangered Species Act (ESA). However, NASCO has also acknowledged that when a stock has fallen well below its CL, or has been below the CL for an extended period, it may be appropriate to consider an intermediate 'recovery' reference point (NASCO, 2004). Given these discrepancies, the USA recommended aligning the management objectives for the USA stock complex with the recovery criteria for the remnant stocks currently under protection of the ESA (NASCO, 2013).

One requirement of the ESA is defining objective, measurable criteria for determining when Atlantic salmon may be considered for de-listing from the Act. The draft recovery criteria for the Gulf of Maine Distinct Population Segment (GOM DPS), the only region where remnant Atlantic salmon populations remain, are a census population abundance of 6000 adult returns of all sea ages, and assuming a 1:1 sex ratio equally distributed among three distinct areas within the GOM DPS. There are additional criteria that must be met before proposing de-listing the GOM DPS, such as demonstrating consistent positive population growth and achieving the census population criteria based on wild spawners only. Further details can be found in Appendix A of the Critical Habitat Designation (http://www.nero.noaa.gov/prot_res/altsalmon).

The fishery at West Greenland primarily exploits (>90%) 1SW non-maturing salmon destined to mature as either 2SW or 3SW salmon. As such, the provision of catch advice for West Greenland is based on the forecasts of 2SW returns compared to the stated management objectives. To convert the draft recovery criteria to 2SW equivalents, the average percentage of 2SW fish in returns to the USA for the base period 2003–2012 was applied (75.8%), resulting in a value of 4549 2SW returns. This value was proposed as a replacement to the previous USA management objective of achieving a 25% increase in returns of 2SW salmon from the average returns in the 1992–1996 base period (2548). The objective would now be stated as: "achieve 2SW adult returns of 4549 or greater for the USA region".

Review of management objective for Scotia–Fundy

A review of the management objective for Scotia–Fundy was also considered by ICES. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) have assessed the salmon stocks of the three Scotia–Fundy Designatable Units (DU) as endangered (at risk of extinction) due to population declines associated with low marine survival and threats in freshwater. Recovery potential assessments (RPAs) of each DU were conducted in 2012 and 2013. The RPA science advisory reports proposed recovery objectives for distribution and abundance which could be considered as an alternative to the presently defined rebuilding management objective for the Scotia–Fundy area. Only the RPA for the Outer Bay of Fundy DU specifically quantified the short-term 2SW abundance target through the identification of priority rivers. No short-term abundance target or priority rivers were identified for the Eastern Cape Breton (DFO, 2013b) and Nova Scotia Southern Upland (DFO, 2013a) regions during the RPAs to allow for similar 2SW target calculations for these regions within Scotia–Fundy.

It is therefore not possible at this time to propose a revised management objective for the Scotia–Fundy region that takes into account advice on recovery targets identified in the recent RPAs for the three DUs of Atlantic salmon in this region. Specific short-term and long-term recovery objectives for distribution and abundance within each DU would be developed during the completion of recovery plans, but these are currently pending. Once such recovery plans are developed it is anticipated that these would provide specific abundance and distribution targets. However, until any such objectives can be assessed for their appropriateness for the provision of management advice for West Greenland, the current management objective of a 25% increase in returns from the average of 1992–1996 can be retained for the following reasons:

1. The current management objective for Scotia–Fundy is aimed at rebuilding the stocks which are well below the 2SW conservation limit for the Scotia–Fundy region (i.e., 44% of the 2SW CL);
2. Recovery objectives in terms of number of fish have not been proposed in scientific recovery potential assessments for two of the three DUs in the Scotia–Fundy region; and
3. If the current management objective is lower than recovery objectives that will be identified from river-specific recovery objectives that have yet to be developed in recovery plans, then there is a low risk of impacting management advice to West Greenland in the short term given the current stock status in relation to existing management objective.

Impact of the revised management objective for USA on catch advice

The existing management objectives used for the provision of catch advice for the West Greenland fishery (ICES, 2012c) are as follows:

- 75% probability of simultaneous attainment of seven management objectives:
    - Meet the 2SW CLs for the four northern areas of NAC (Labrador, Newfoundland, Québec, Gulf);
    - Achieve a 25% increase in returns of 2SW salmon from the average returns in 1992–1996 for the Scotia–Fundy and USA regions;
    - Meet the MSW southern NEAC CL.

To evaluate the implications of the proposed new management objective, the most recent catch options provided for the West Greenland fishery (ICES, 2012c) were compared to a re-analysis of the catch options, using the same input data, but with the inclusion of the proposed new USA stock complex management objective.

The scientific advice has been for zero harvest of the mixed-stock complex at West Greenland since 2002. The probabilities of meeting each individual management objective and simultaneously meeting all seven objectives for the period of 2012–2014 under the existing and the proposed new USA management objectives are provided in Table 10.1.12.1. The time-series of 2SW returns against the USA CL, the existing, and the proposed new management objectives is provided in Figure 10.1.12.2.

Due to the record high returns in USA rivers in 2011 (the highest in the time-series since 1990 and the sixth highest since 1971), the probability of meeting the existing management objective for the USA stock complex based on a forecast of USA returns in the years 2012–2014 ranged from 75% to 89%. However, realized returns of 2SW fish were well below the forecast values for 2012 and 2013 and were < 30% of the 2011 returns (Figure 10.1.12.2).

Prior to 2012, the probability of USA returns exceeding the management objective was assessed jointly with the Scotia–Fundy stock complex and therefore cannot be reported independently. However, for the five years during which catch options were provided prior to this time, the probability of USA and Scotia–Fundy returns jointly exceeding their management objectives remained below 5% in each year (ICES, 2004b, 2005b, 2006, 2007, 2009a).

For the years 2012 to 2014, there is a 0.16–0.23 reduction in the probability of the USA stock complex meeting the proposed new management objective (range 0.50 to 0.70) compared to meeting the existing management objective (range 0.75 to 0.89) (Table 10.1.12.1). However, the provision of catch advice for the West Greenland fishery depends on the simultaneous achievement of all seven management objectives with a probability of at least 0.75. It is therefore most appropriate to evaluate changes in the simultaneous probability between the two scenarios. The probability difference for simultaneously achieving all seven management objectives for both options of USA management objectives is only 0.01 (i.e. 1%). As such, the proposed modification of the USA management objective would have had a negligible impact on the catch advice for the 2012–2014 fishing years. The USA stock complex is a single component of the West Greenland fishery and the management of the fishery is dependent on the performance of all contributing stock complexes.

Further considerations

ICES noted that the protocols for updating the management objectives if and when stocks recover have not been developed. The management objectives for the southern regions are interim objectives intended to guide management in assessing progress in increasing abundance of Atlantic salmon, while not unduly restricting Greenland and domestic governments from exploiting stocks that are at high abundance and achieving their conservation objectives. Ultimately, the catch options for the fishery at West Greenland should be assessed against the 2SW conservation limits for each of the contributing regions.

10.1.13 Relevant data deficiencies, monitoring needs, and research requirements

NASCO subgroup on telemetry

ICES received an update on the work of the NASCO Sub Group on Telemetry that had been established by the Scientific Advisory Group (SAG) to the International Atlantic Salmon Research Board (IASRB). Following discussions within the IASRB about the future direction of research that might be supported by the Board, the Sub Group had been asked to develop an outline proposal for a large-scale international collaborative telemetry project to ultimately provide information on migration paths and quantitative estimates of mortality during phases of the marine life-cycle of salmon. Tracking projects undertaken in the US (Gulf of Maine) and Canada (Gulf of St Lawrence) based on acoustic tagging have demonstrated the potential for such methods to be used to identify the migration routes of emigrating post-smolts and to quantify the mortality occurring during different phases of this migration (see Section 10.1.6.3). Similarly, trials with pop-off satellite transmitters on salmon caught at West Greenland and kelts returning to sea after spawning have demonstrated the potential for elucidating the migration routes and behaviour of salmon at later life stages, including the return migration from the ocean feeding areas towards their home rivers. Satellite tags and archival tags have also been used to obtain additional information on conditions experienced by salmon at sea. The proposed programme will build on these studies to extend the areas for which detailed information on marine mortality is available.

ICES recognised that this would be a very challenging programme, but considered that it could provide important information that would greatly assist in the management and conservation of Atlantic salmon stocks throughout the North Atlantic.

EU Data Collection – Multi-Annual Plan

ICES received an update on the ongoing process for the revision of the EU Data Collection Framework (DCF) as it affects the collection of data used in the assessment of Atlantic salmon stocks and the provision of management advice. Changes to the DCF in 2007 introduced requirements for EU Member States to collect data on eel and salmon, but the specific data requested for these species did not meet the needs of national and international assessments. In 2012, the Workshop on Eel and Salmon Data Collection Framework (ICES, 2012b) provided detailed recommendations on the data requirements for European eel, and Baltic and Atlantic salmon, including data required by ICES to address questions posed by NASCO. In February 2014, these recommendations were presented to an Expert Working Group of the EU Scientific, Technical and Economic Committee for Fisheries (STECF). A number of suggestions were made for changes to Council Regulation 199/2008 (concerning the establishment of a Community framework for the collection, management, and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy) and Commission Decision 2010/93/EU (adopting a multiannual Community programme for the collection, management, and use of data in the fisheries sector for the period 2011–2013), which will be considered by STECF in March 2014. The revised DFC will provide the basis for data collection under the proposed Multi-Annual Plans (DC-MAP) which will apply for the period 2015 to 2021.

Stock annex development

ICES considered proposals from the Review Group regarding the establishment of an Atlantic Salmon Stock Annex. Such stock annexes have been developed for other ICES assessment working group reports and are intended to provide a complete description of the methodology used in conducting stock assessments and the provision of catch advice. ICES developed a Stock Annex incorporating country-specific inputs for the 2014 WGNAS meeting. These documents are intended to be informative for members of WGNAS and reviewers, as well as in facilitating wider communication.

Recommendations

The Working Group on North Atlantic Salmon recommends that it should meet in 2015 to address questions posed by ICES, including those posed by NASCO. WGNAS may be invited to hold its next meeting in Canada, but would otherwise intend to convene at ICES Headquarters in Copenhagen, Denmark. The meeting will be held from 17 to 26 March 2015.

Specific list of recommendations:

1) The Working Group recommends the following actions to improve our understanding of salmon bycatch:

   1.1) Collate all available information on post-smolt and salmon marine distribution, particularly from the SALSEA–Merge project.
   1.2) Collate information of possible interceptive pelagic fisheries operating in the identified migration routes and feeding areas of Atlantic salmon. This would require close cooperation with scientists working on pelagic fish assessments in the relevant areas and provision of disaggregated catch data in time and space which overlap areas known to have high densities of post-smolts or adults.
   1.3) Review pelagic fisheries, identifying important factors such as gear type and deployment, effort and time of fishing in relation to known distribution of post-smolt and salmon in space and time, and investigate ways to intercalibrate survey trawls with commercial trawls.
   1.4) Carry out comprehensive catch screening on commercial vessels fishing in areas with known high densities of salmon post-smolts or adults. This would require significant resources and would need to be a well coordinated and well-funded programme.
   1.5) Integrate information and model consequences for productivity for salmon from different regions of Europe and America.

   The Working Group recommends that this might be approached as a phased investigation with the first elements of such a programme possibly carried out by a combined salmon/pelagic species workshop or study group. The major element (catch screening) would likely require some preparation and agreement between NASCO parties and could be conducted as a joint collaborative exercise with cooperation from the pelagic fishing industry.

2) The Working Group recommends that sampling and supporting descriptions of the Labrador and Saint-Pierre et Miquelon fisheries be continued and expanded (i.e. sample size, geographic coverage, tissue samples, seasonal distribution of the samples) in future years and analysed using the North American

genetic baseline to improve the information on biological characteristics and stock origin of salmon harvested in these mixed-stock fisheries.

3) The Working Group recommends that the Greenland catch reporting system continues and that logbooks be provided to all fishers. Efforts should continue to encourage compliance with the logbook voluntary system. Detailed statistics related to catch and effort should be made available to the Working Group for analysis.

4) The Working Group recommends that the Government of Greenland facilitate the coordination of sampling within factories receiving Atlantic salmon, if landings to factories are allowed in 2014. Sampling could be conducted by samplers participating in the international sampling programme or by factory staff working in close coordination with the sampling programme coordinator. The Working Group also recommends that arrangements be made to enable sampling in Nuuk as a significant amount of salmon is reported as being landed in this community on an annual basis.

5) The Working Group recommends that the longer time-series of sampling data from West Greenland should be analysed to assess the extent of the variations in fish condition over the time period corresponding to the large variations in productivity as identified by the NAC and NEAC assessment and forecast models. Progress has been made compiling the West Greenland sampling database and should be available for analysis prior to the 2015 Working Group meeting.

6) The Working Group recommends a continuation and expansion of the broad geographic sampling programme at West Greenland (multiple NAFO divisions) to more accurately estimate continent of origin in the mixed-stock fishery.

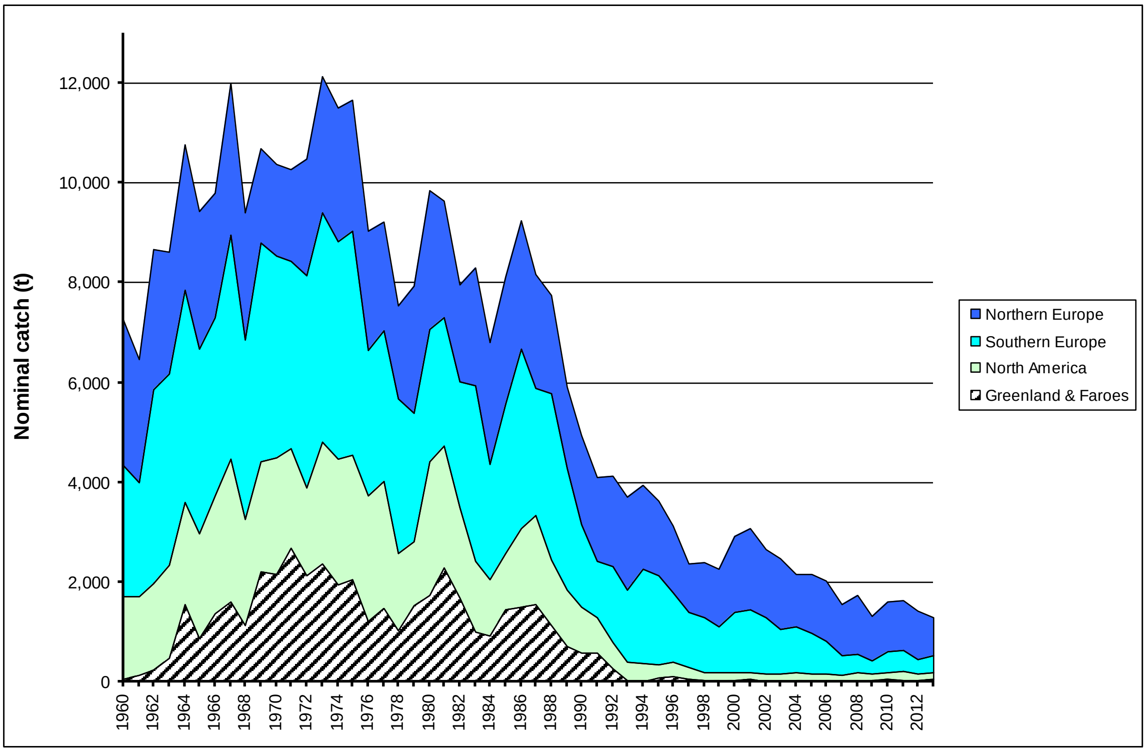

Figure 10.1.5.1 Reported total nominal catch of salmon (tonnes round fresh weight) in four North Atlantic regions, 1960 to 2013.

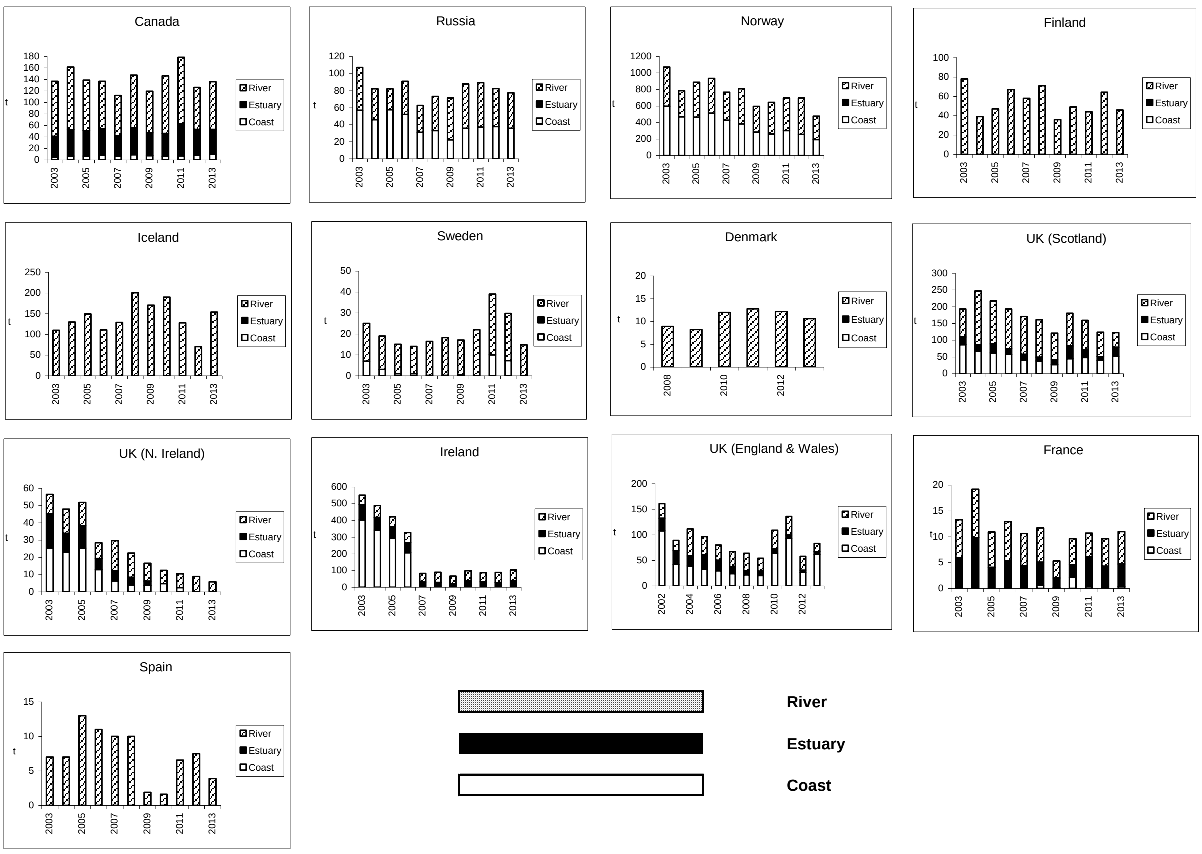

Figure 10.1.5.2 Nominal catch (t) by country taken in coastal, estuarine, and riverine fisheries, 2003–2013 (except Denmark: 2008–2013). Note that the scales of the vertical axes vary.

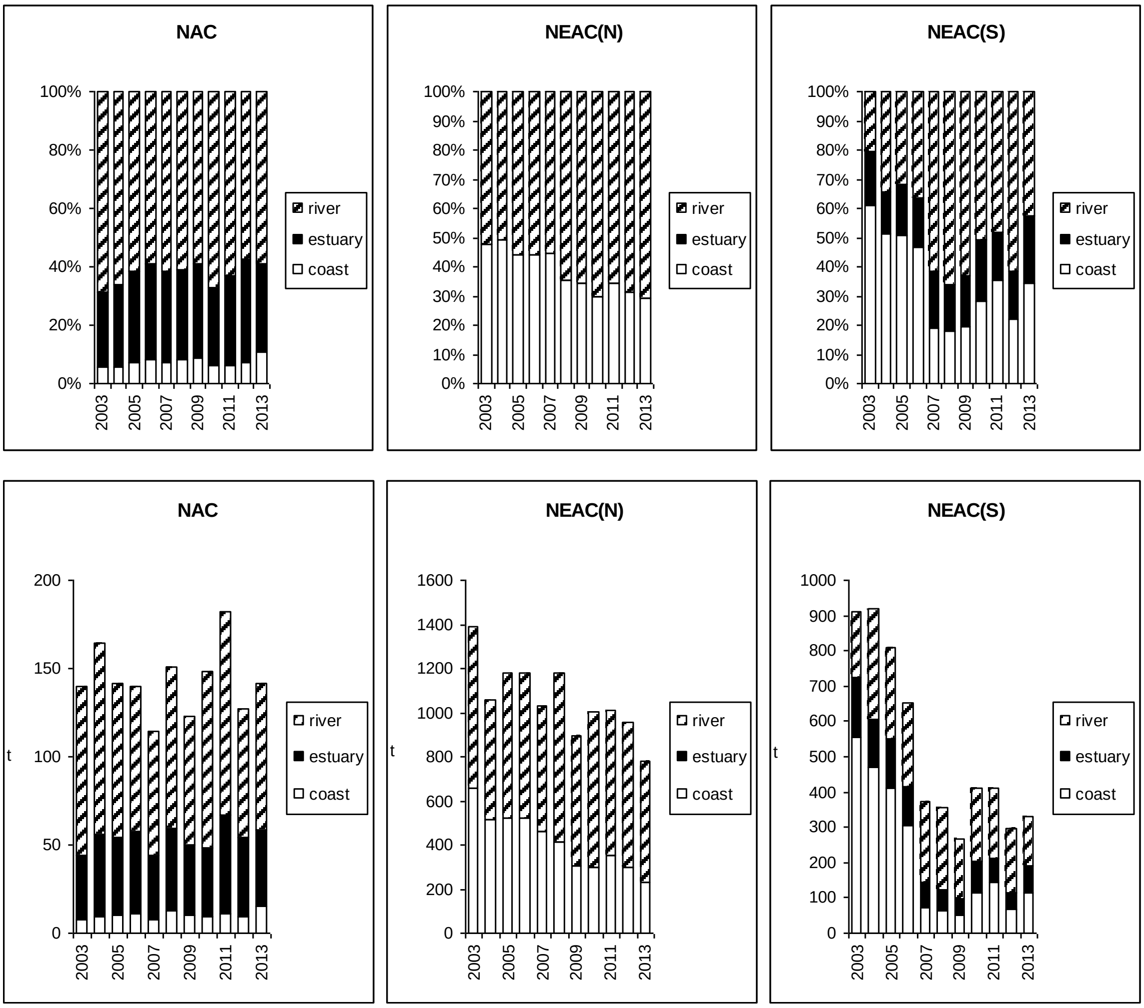

Figure 10.1.5.3 Percentages of nominal catch (top panel) and nominal catch in tonnes (bottom panel) taken in coastal, estuarine, and riverine fisheries for the NAC area, and for the northern and southern NEAC areas, 2003–2013. Note that scales of vertical axes vary in the bottom panels.

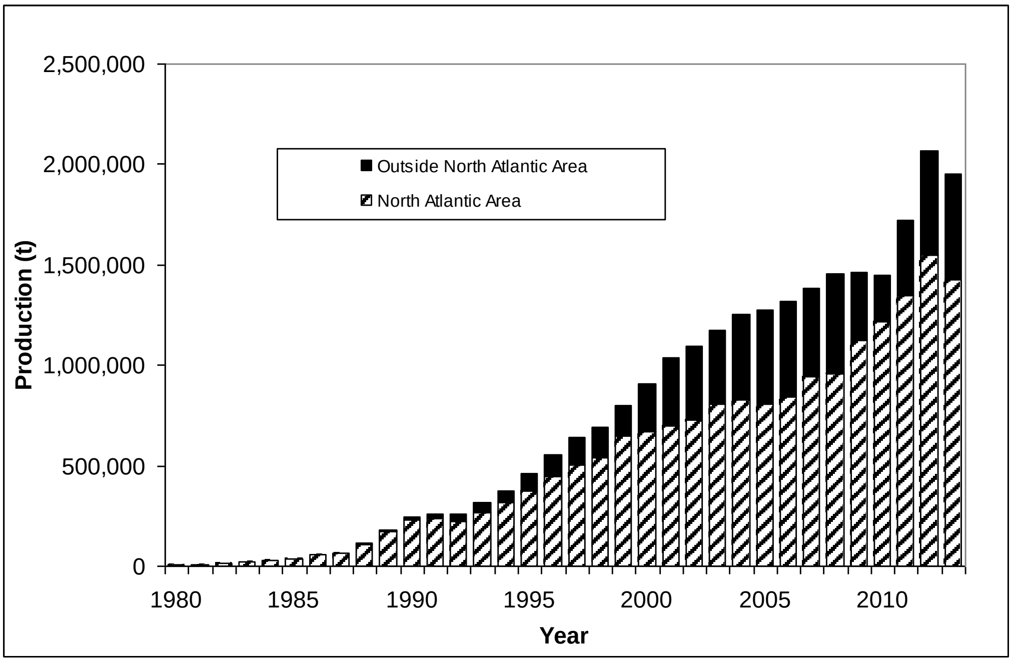

Figure 10.1.5.4 Worldwide production of farmed Atlantic salmon, 1980 to 2013.

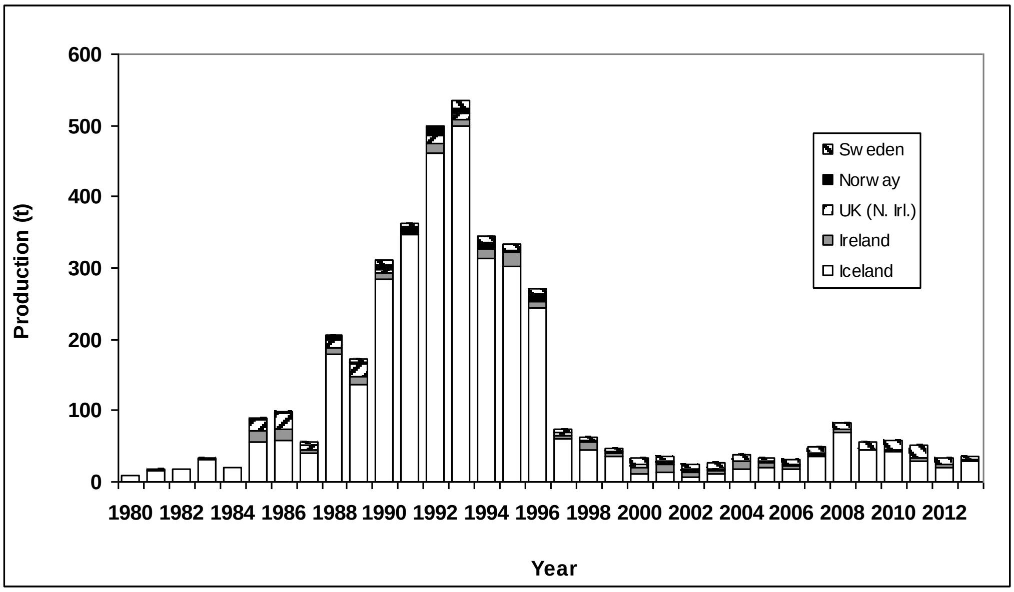

Figure 10.1.5.5 Production of ranched Atlantic salmon (tonnes round fresh weight) in the North Atlantic, 1980 to 2013.

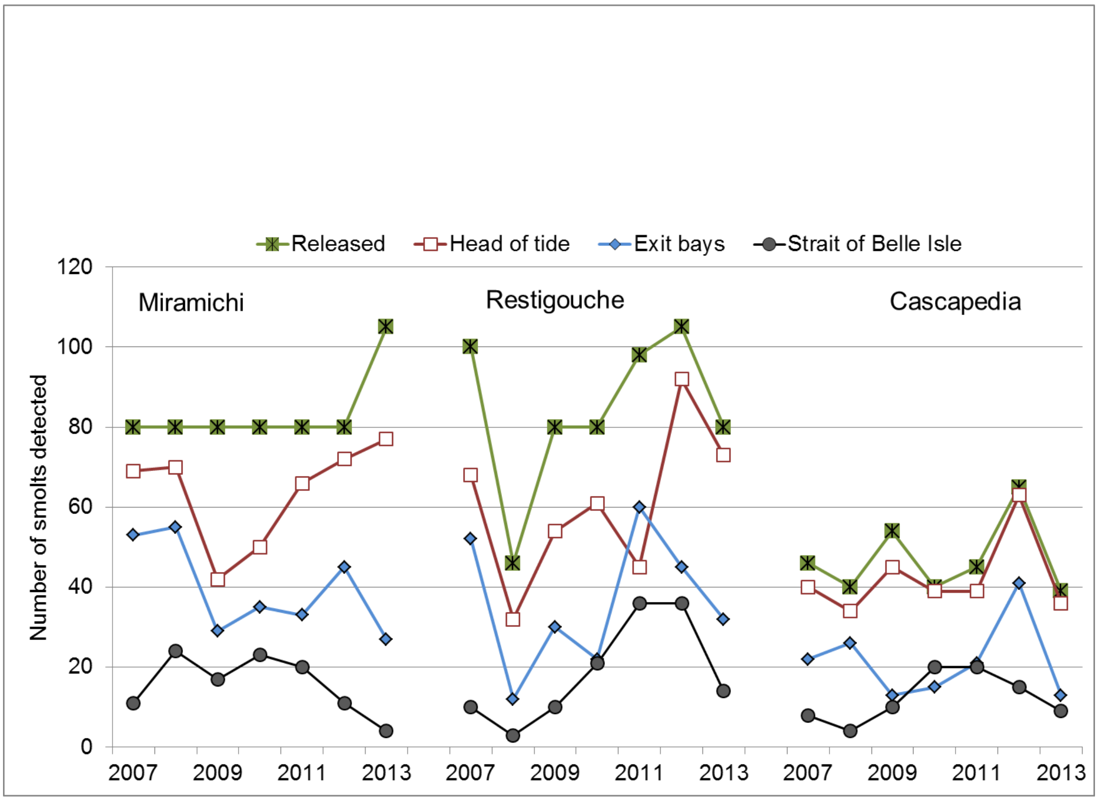

Figure 10.1.6.3 Number of smolts tagged and released from the Miramichi, Restigouche, and Cascapedia rivers, and subsequently detected at the head of tide, exit of bays, and Strait of Belle Isle arrays in 2007 to 2013.

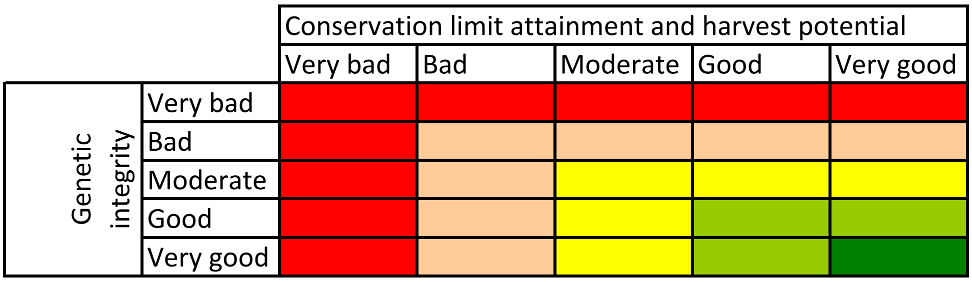

Figure 10.1.6.5 The Norwegian quality norm classification system. Note: the poorest classification in any of the dimensions determines the final classification of the stock.

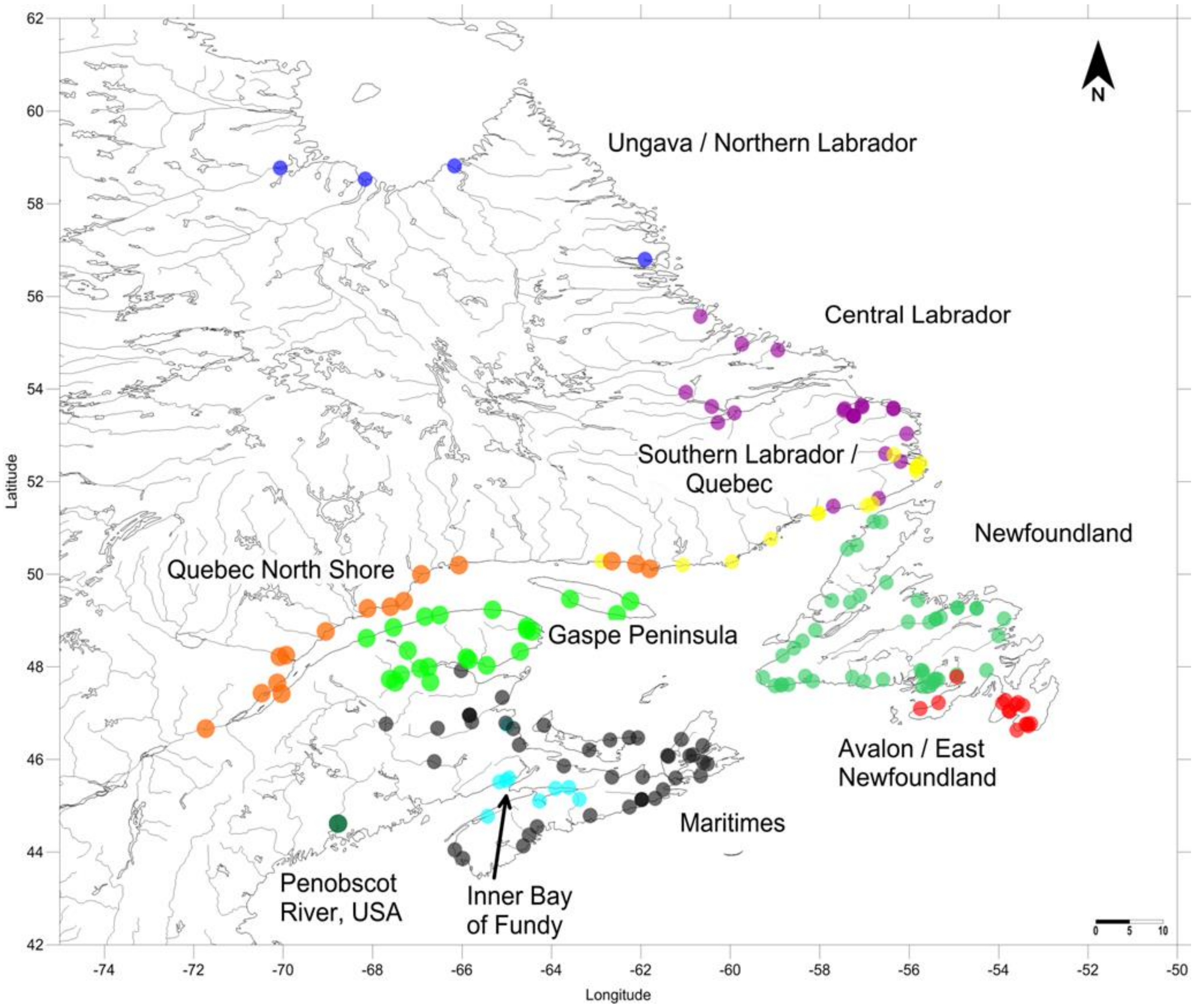

Figure 10.1.6.8 Map of baseline samples and 11 reporting groups used in the mixture and assignment analysis of Bradbury *et al.* (in press) for Labrador Aboriginal and subsistence mixed-stock fisheries.

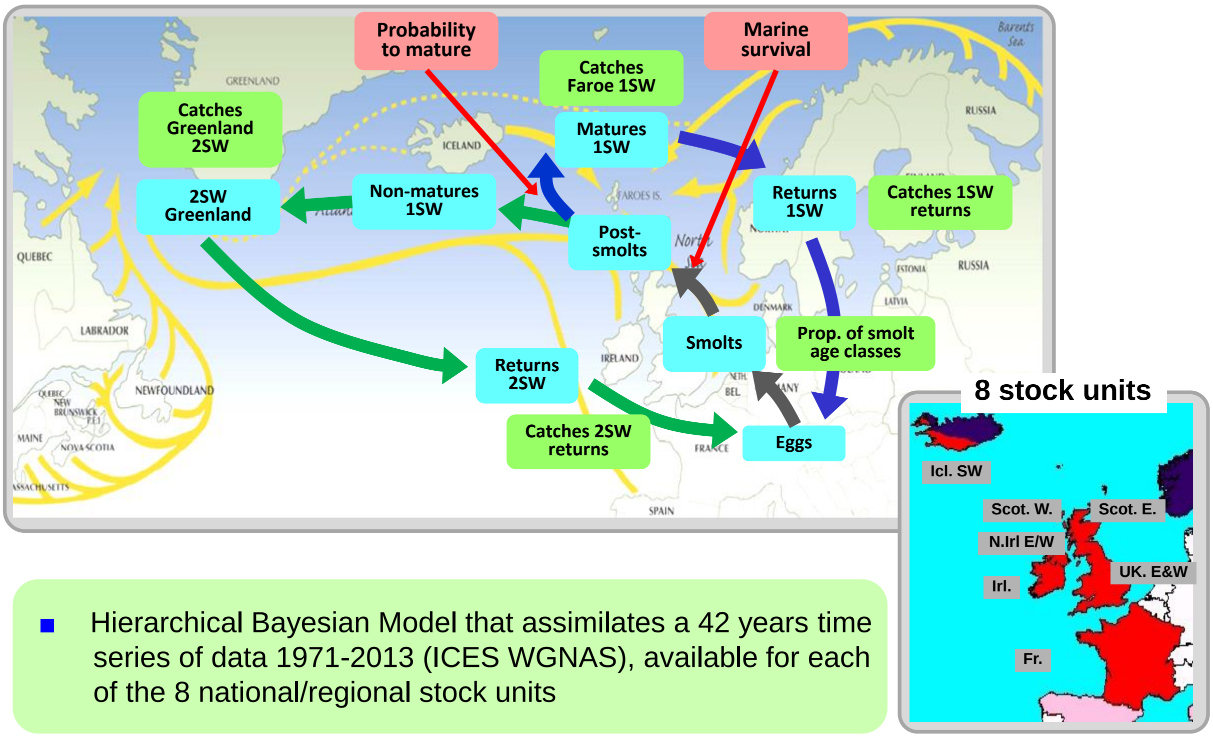

Figure 10.1.6.9.1 The integrated life-cycle model developed for each stock unit of the Southern NEAC stock complex. The eight stock units are: UK (Scotland) – east and west (2 units), UK (England & Wales; 1 unit), UK (N. Ireland) – east and west (2 units), Ireland (1 unit), France (1 unit), and south and west Iceland (1 unit). Variables in light blue are the main stages considered in the age- and stage-structured model. Arrows in blue and green are the fish that mature after the first and second winter at sea. Variables in light green indicate the main sources of data assimilated in the model. The post-smolt marine survival and the probability of maturing are the key parameters estimated in the model. The hierarchical structure provides a tool for separating out signals in demographic traits at different spatial scales: (1) a common trend shared by all stock units and, (2) fluctuations specific to each stock unit.

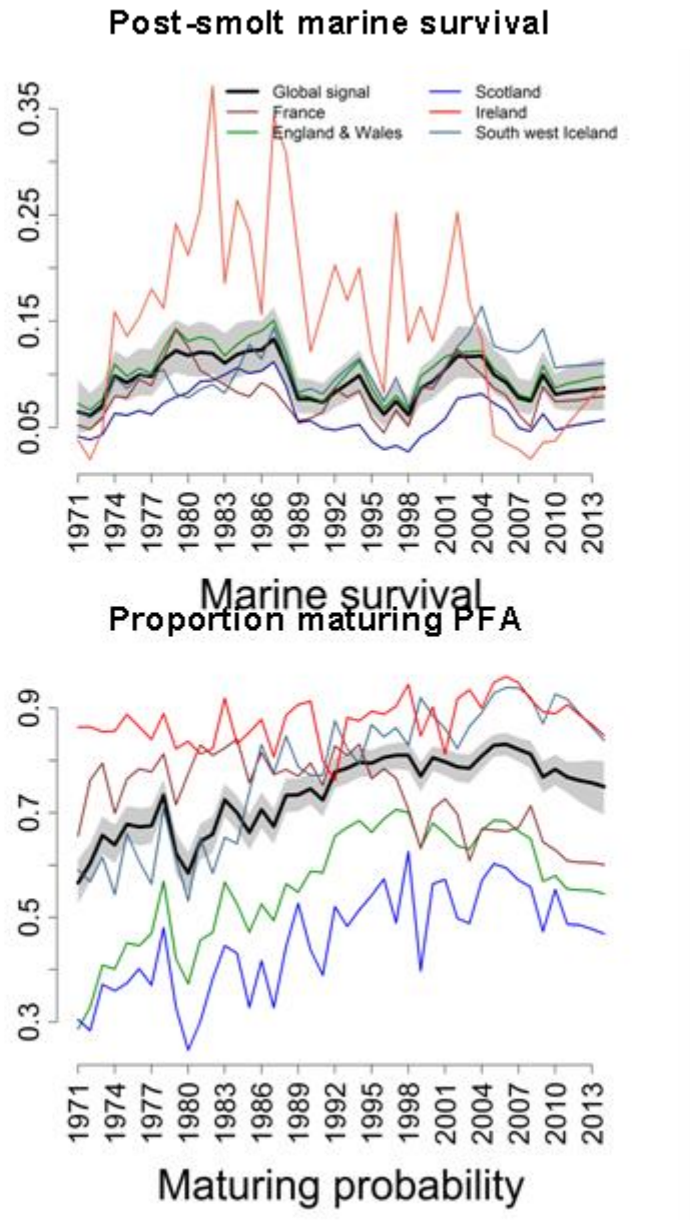

Figure 10.1.6.9.2 Time-series of estimates of post-smolt marine survival and probability to mature after the first winter at sea. The solid black line indicates the trend shared by all stock complexes together with the associated Bayesian uncertainty (95% Bayesian credible interval). Other solid lines are the medians of Bayesian posterior distributions. Even if the data are available at the scale of eight regions (see Figure 10.1.6.9.1), only five stock complexes have been considered regarding the spatial variability of the post-smolt marine survival and the probability of maturing after the first winter at sea: France, UK (England & Wales), Ireland + UK (N. Ireland), UK (Scotland), and Iceland-SW.

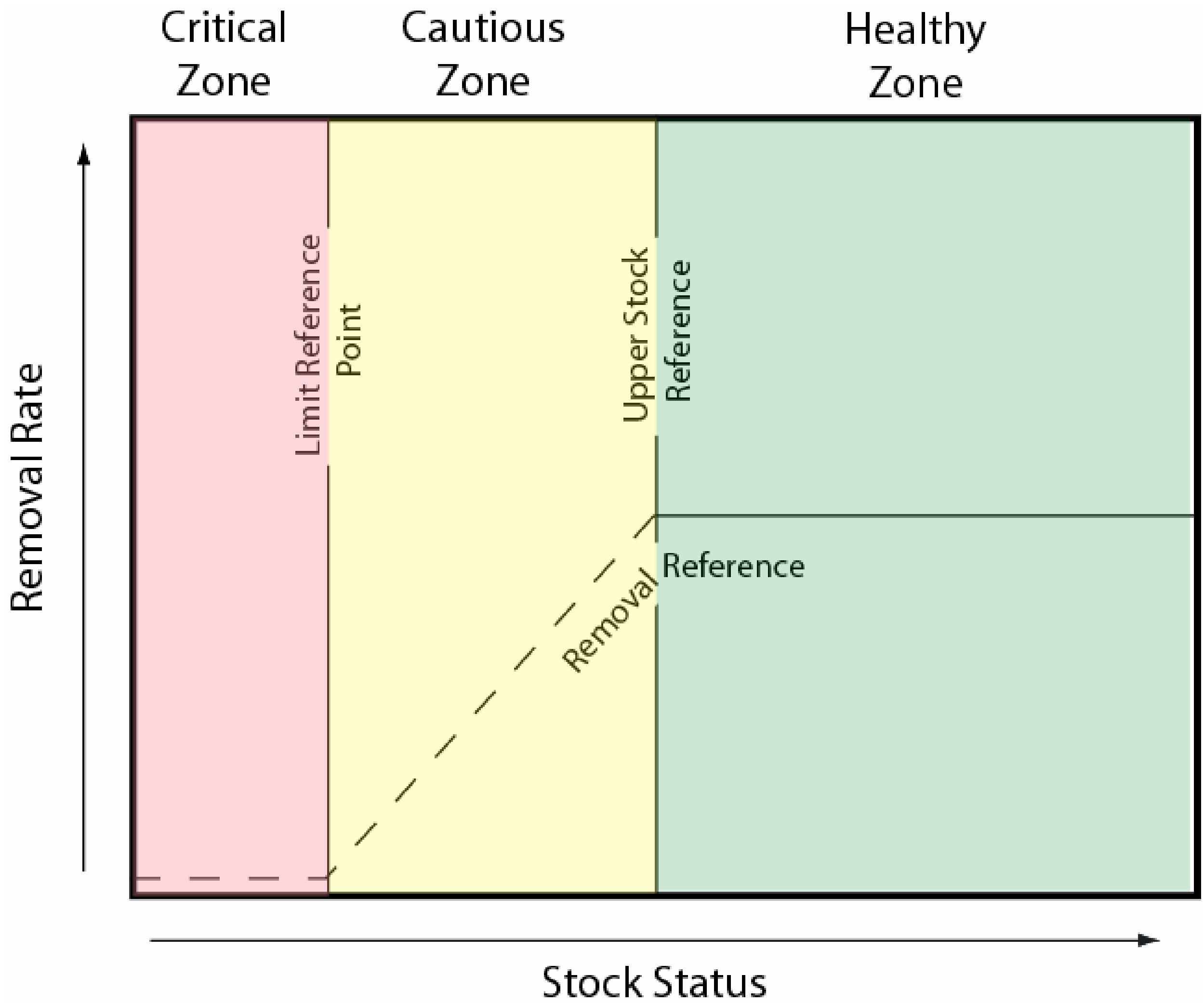

Figure 10.1.8.1 Canadian fisheries management framework consistent with the precautionary approach (Source: DFO, 2006).

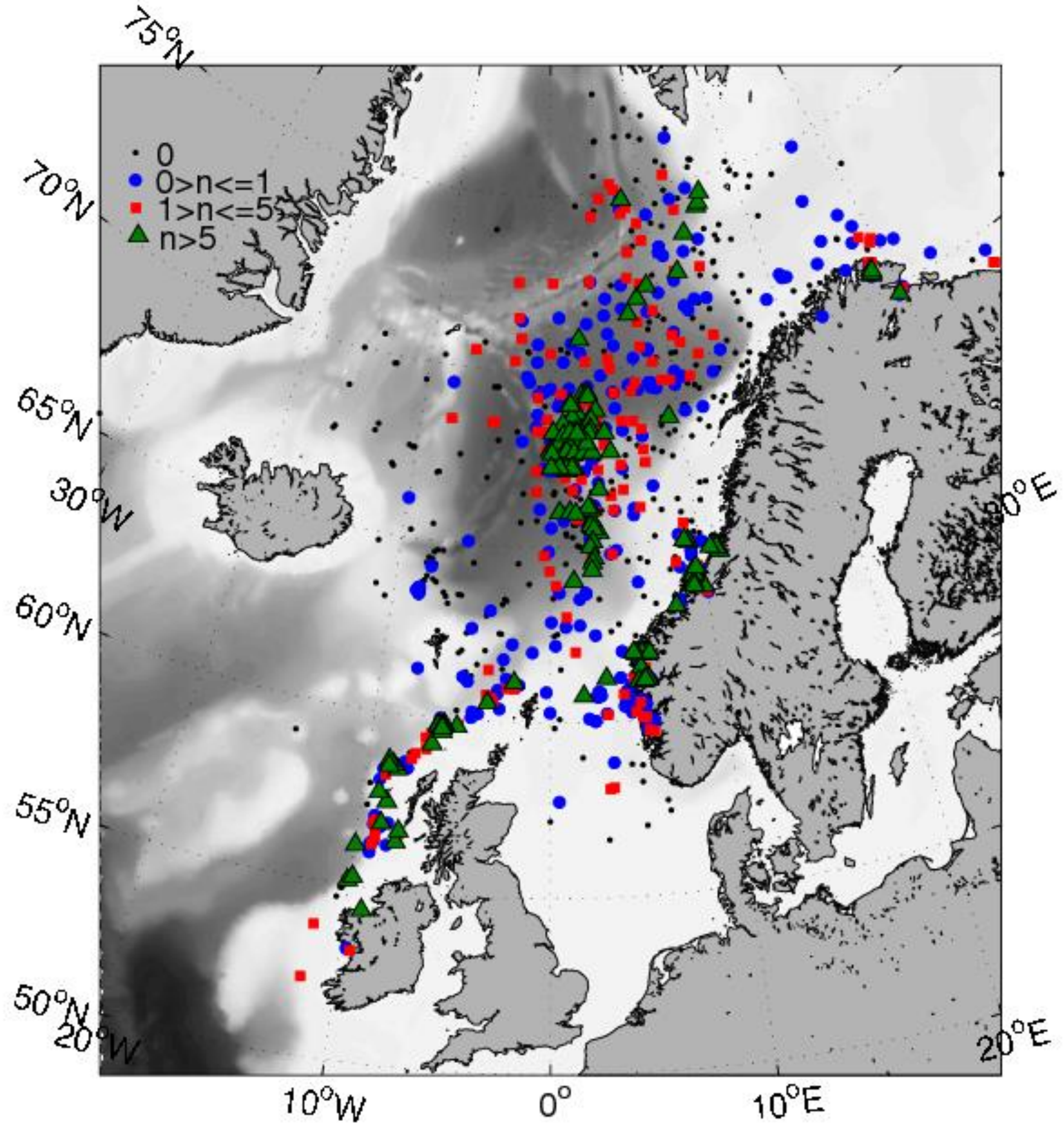

Figure 10.1.11.1 Distribution of Atlantic salmon post-smolts (number per hour of trawling). Data from the SALSEA–Merge project and earlier research cruises. Data are aggregated over a number of years from 1994 on, with the majority of fish being caught in the period May to August.

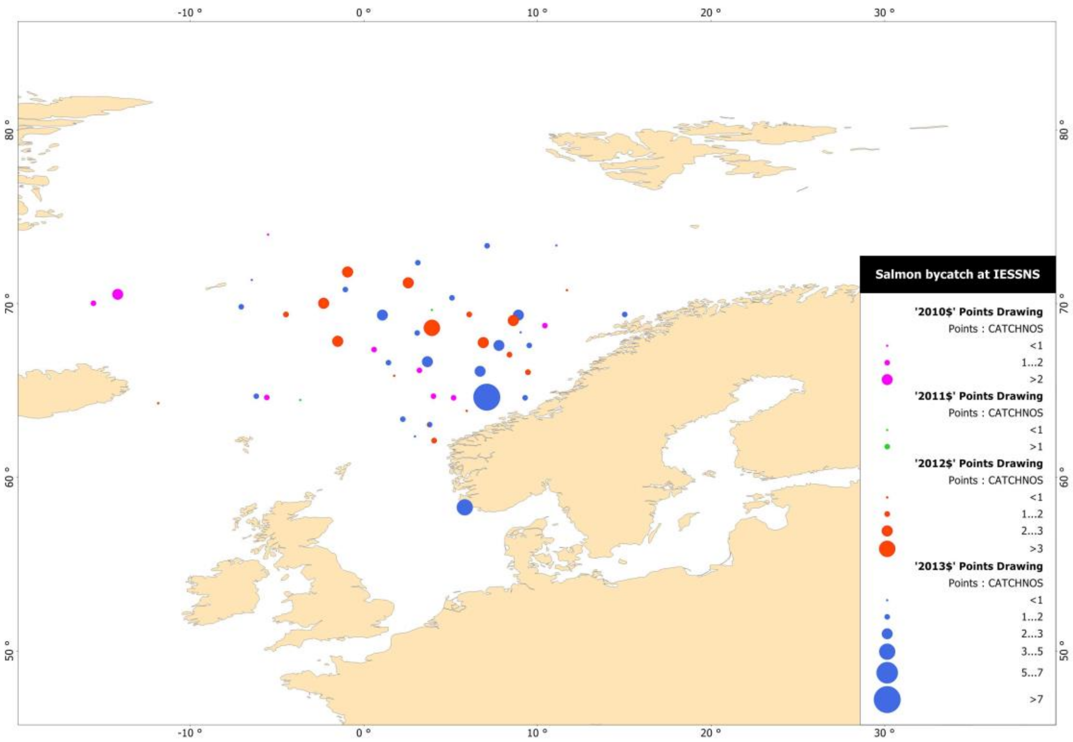

Figure 10.1.11.2 Salmon bycatch in the IESSNS surveys 2010–2013. The size of the bubbles show the number of salmon caught and the colour of the bubbles are coded by year, see legend on map.

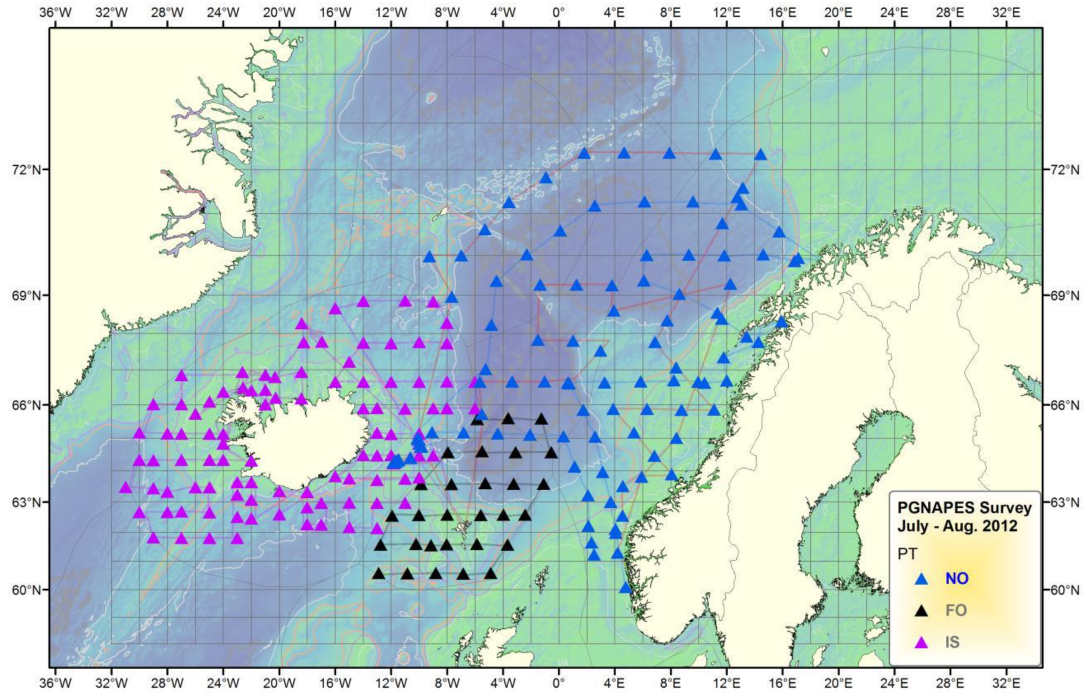

Figure 10.1.11.3 Cruise tracks and pelagic trawl stations shown for RV "G. O. Sars" in green, MV "Brennholm" (Norway) in blue, MV "Christian í Grótinum" (Faroe Islands) in black, and RV "Arni Fridriksson" (Iceland) in red within the covered areas of the Norwegian Sea and surrounding waters from 2 July to 10 August 2012.

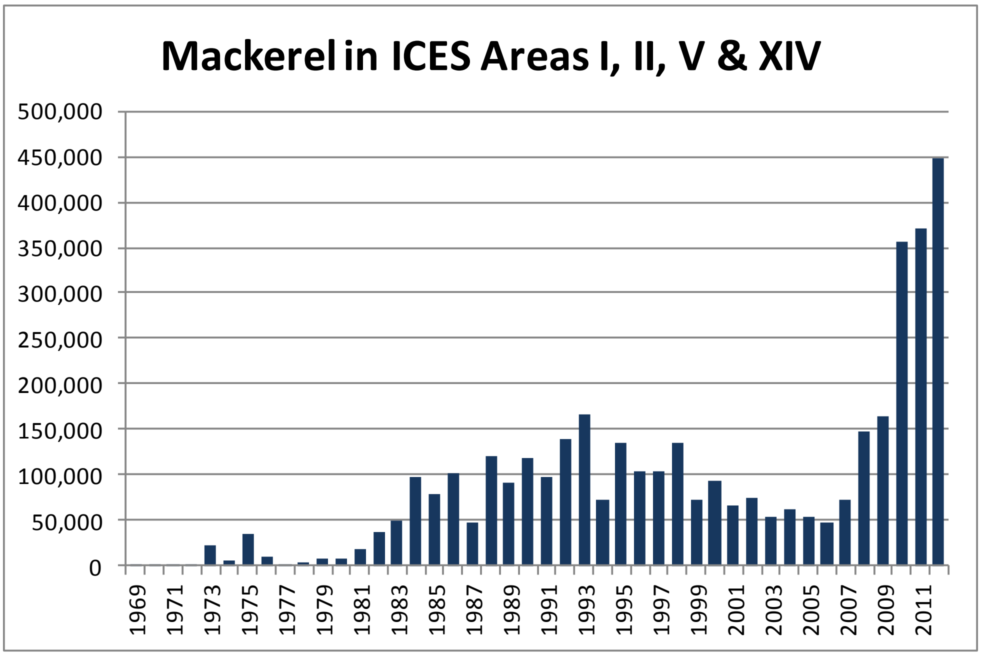

Figure 10.1.11.4 Reported mackerel catches (t) in ICES Subareas I, II, V, and XIV, 1969–2012 (from ICES, 2013b).

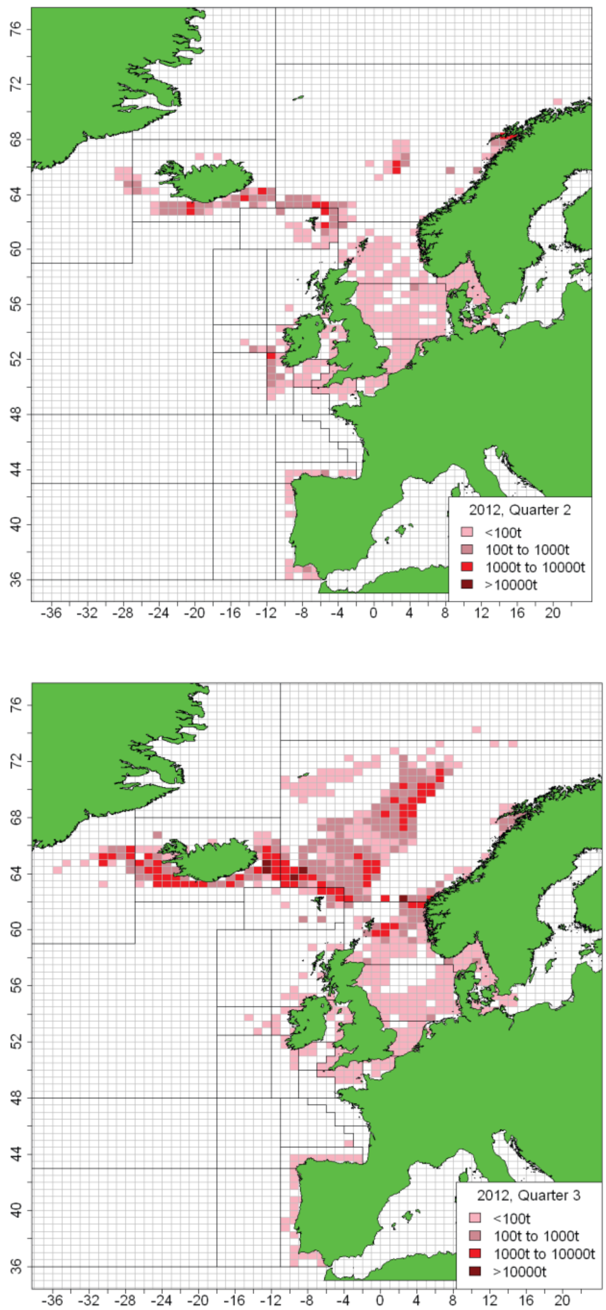

Figure 10.1.11.5 Distribution of mackerel catches in the Northeast Atlantic for 2012 for quarter 2 (upper panel) and quarter 3 (lower panel) (from ICES, 2013b).

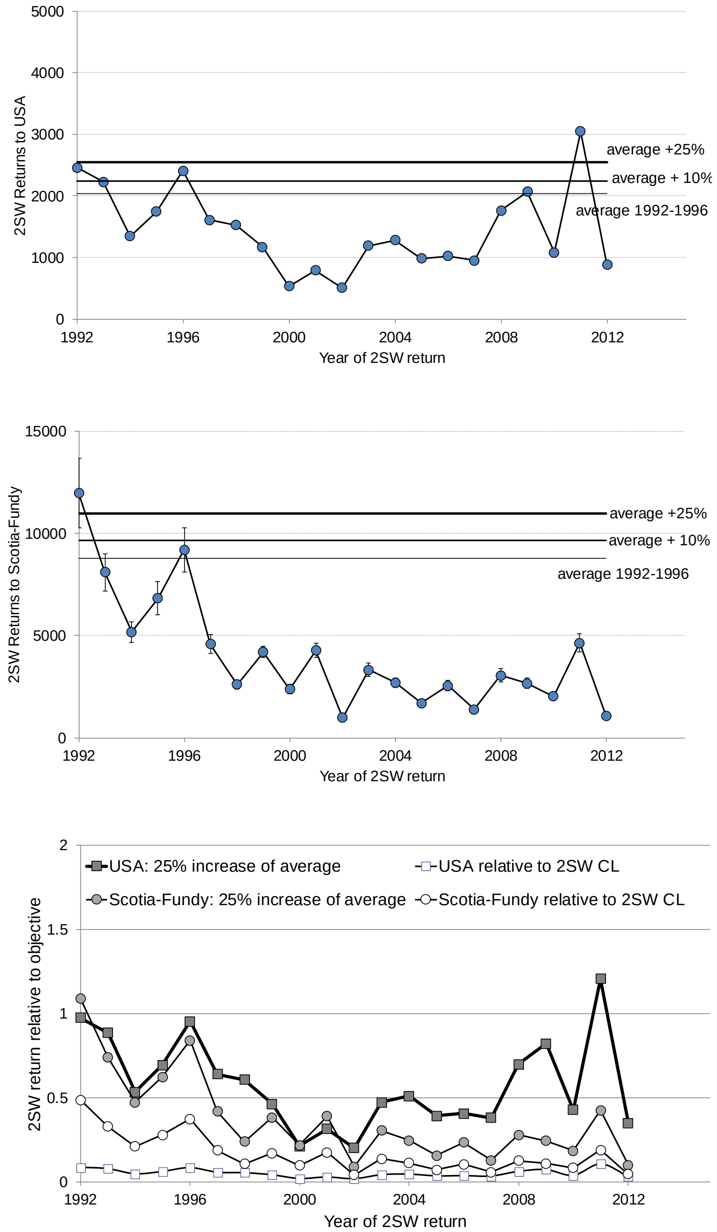

Figure 10.1.12.1 Median returns of 2SW salmon to the USA (upper panel) and Scotia–Fundy regions (middle panel, 5th to 95th percentile error bars) and the ratio of the returns to the management objective (25% increase from the average returns of 1992–1996, 2SW CL) for Scotia–Fundy and USA (lower panel) for 1992 to 2012.

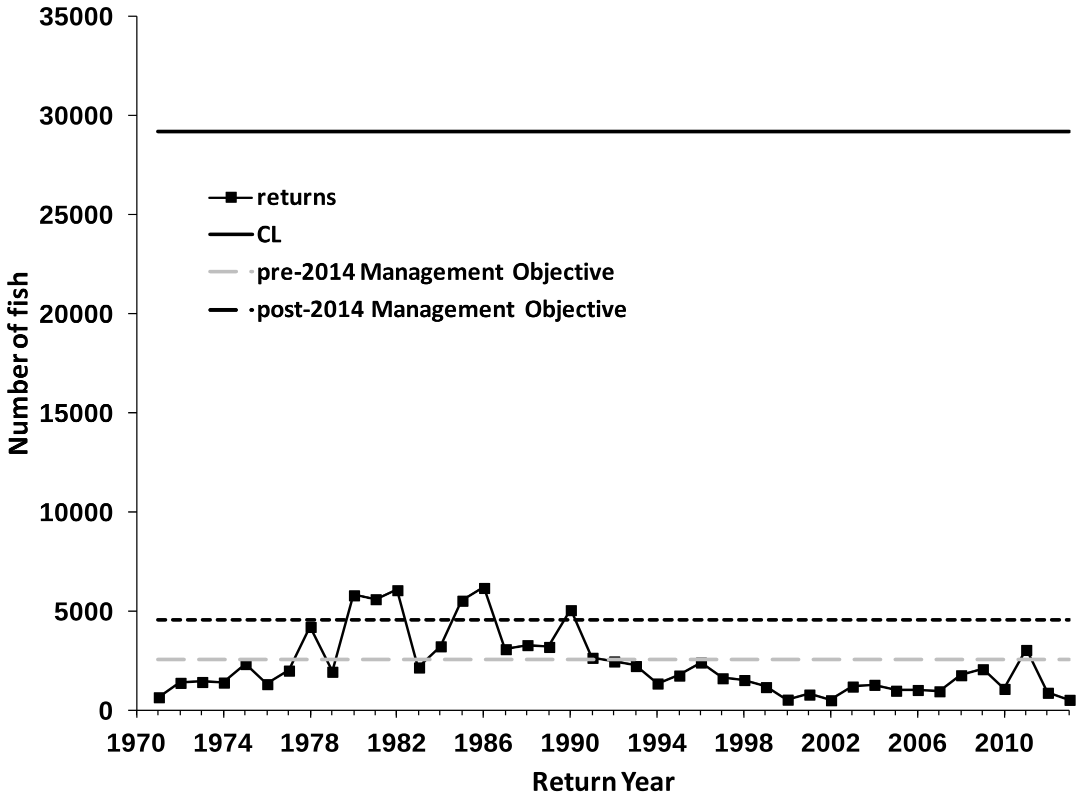

Figure 10.1.12.2 US returns (1971–2012) compared against three different management objectives: US stock complex CL (29 199), the existing Management Objective (2548), and the proposed new Management Objective (4549).

Table 10.1.5.1 Reported total nominal catches of salmon by country (in tonnes round fresh weight), 1960 to 2013 (2013 figures include provisional data).

	NAC Area			NEAC (N. Area)								NEAC (S. Area)						Faroes & Greenland				Total	Unreported catches	
Year	Canada (1)	USA	St. P&M	Norway (2)	Russia (3)	Iceland Wild	Iceland Ranch (4)	Sweden Wild	Sweden Ranch (15)	Denmark	Finland	Ireland (5,6)	UK (E & W)	UK (N.Irl.) (6,7)	UK (Scotl.)	France (8)	Spain (9)	Faroes (10)	East Grld.	West Grld. (11)	Other (12)	Reported Nominal Catch	NASCO Areas (13)	International waters (14)
1960	1,636	1	-	1,659	1,100	100	-	40	0	-	-	743	283	139	1,443	-	33	-	-	60	-	7,237	-	-
1961	1,583	1	-	1,533	790	127	-	27	0	-	-	707	232	132	1,185	-	20	-	-	127	-	6,464	-	-
1962	1,719	1	-	1,935	710	125	-	45	0	-	-	1,459	318	356	1,738	-	23	-	-	244	-	8,673	-	-
1963	1,861	1	-	1,786	480	145	-	23	0	-	-	1,458	325	306	1,725	-	28	-	-	466	-	8,604	-	-
1964	2,069	1	-	2,147	590	135	-	36	0	-	-	1,617	307	377	1,907	-	34	-	-	1,539	-	10,759	-	-
1965	2,116	1	-	2,000	590	133	-	40	0	-	-	1,457	320	281	1,593	-	42	-	-	861	-	9,434	-	-
1966	2,369	1	-	1,791	570	104	2	36	0	-	-	1,238	387	287	1,595	-	42	-	-	1,370	-	9,792	-	-
1967	2,863	1	-	1,980	883	144	2	25	0	-	-	1,463	420	449	2,117	-	43	-	-	1,601	-	11,991	-	-
1968	2,111	1	-	1,514	827	161	1	20	0	-	-	1,413	282	312	1,578	-	38	5	-	1,127	403	9,793	-	-
1969	2,202	1	-	1,383	360	131	2	22	0	-	-	1,730	377	267	1,955	-	54	7	-	2,210	893	11,594	-	-
1970	2,323	1	-	1,171	448	182	13	20	0	-	-	1,787	527	297	1,392	-	45	12	-	2,146	922	11,286	-	-
1971	1,992	1	-	1,207	417	196	8	17	1	-	-	1,639	426	234	1,421	-	16	-	-	2,689	471	10,735	-	-
1972	1,759	1	-	1,578	462	245	5	17	1	-	32	1,804	442	210	1,727	34	40	9	-	2,113	486	10,965	-	-
1973	2,434	3	-	1,726	772	148	8	22	1	-	50	1,930	450	182	2,006	12	24	28	-	2,341	533	12,670	-	-
1974	2,539	1	-	1,633	709	215	10	31	1	-	76	2,128	383	184	1,628	13	16	20	-	1,917	373	11,877	-	-
1975	2,485	2	-	1,537	811	145	21	26	0	-	76	2,216	447	164	1,621	25	27	28	-	2,030	475	12,136	-	-
1976	2,506	1	3	1,530	542	216	9	20	0	-	66	1,561	208	113	1,019	9	21	40	<1	1,175	289	9,327	-	-
1977	2,545	2	-	1,488	497	123	7	9	1	-	59	1,372	345	110	1,160	19	19	40	6	1,420	192	9,414	-	-
1978	1,545	4	-	1,050	476	285	6	10	0	-	37	1,230	349	148	1,323	20	32	37	8	984	138	7,682	-	-
1979	1,287	3	-	1,831	455	219	6	11	1	-	26	1,097	261	99	1,076	10	29	119	<0,5	1,395	193	8,118	-	-
1980	2,680	6	-	1,830	664	241	8	16	1	-	34	947	360	122	1,134	30	47	536	<0,5	1,194	277	10,127	-	-
1981	2,437	6	-	1,656	463	147	16	25	1	-	44	685	493	101	1,233	20	25	1,025	<0,5	1,264	313	9,954	-	-
1982	1,798	6	-	1,348	364	130	17	24	1	-	54	993	286	132	1,092	20	10	606	<0,5	1,077	437	8,395	-	-
1983	1,424	1	3	1,550	507	166	32	27	1	-	58	1,656	429	187	1,221	16	23	678	<0,5	310	466	8,755	-	-
1984	1,112	2	3	1,623	593	139	20	39	1	-	46	829	345	78	1,013	25	18	628	<0,5	297	101	6,912	-	-
1985	1,133	2	3	1,561	659	162	55	44	1	-	49	1,595	361	98	913	22	13	566	7	864	-	8,108	-	-
1986	1,559	2	3	1,598	608	232	59	52	2	-	37	1,730	430	109	1,271	28	27	530	19	960	-	9,255	315	-
1987	1,784	1	2	1,385	564	181	40	43	4	-	49	1,239	302	56	922	27	18	576	<0,5	966	-	8,159	2,788	-
1988	1,310	1	2	1,076	420	217	180	36	4	-	36	1,874	395	114	882	32	18	243	4	893	-	7,737	3,248	-
1989	1,139	2	2	905	364	141	136	25	4	-	52	1,079	296	142	895	14	7	364	-	337	-	5,904	2,277	-
1990	911	2	2	930	313	141	285	27	6	13	60	567	338	94	624	15	7	315	-	274	-	4,925	1,890	180-350

Table 10.1.5.1 continued.

	NAC Area			NEAC (N. Area)								NEAC (S. Area)						Faroes & Greenland				Total	Unreported catches	
													UK	UK	UK				East	West		Reported		
Year	Canada	USA	St. P&M	Norway	Russia	Iceland		Sweden		Denmark	Finland	Ireland	(E & W)	(N.Irl.)	(Scotl.)	France	Spain	Faroes	Grld.	Grld.	Other	Nominal	NASCO	International
	(1)			(2)	(3)	Wild	Ranch (4)	Wild	Ranch (15)			(5,6)		(6,7)		(8)	(9)	(10)		(11)	(12)	Catch	Areas (13)	waters (14)
1991	711	1	1	876	215	129	346	34	4	3	70	404	200	55	462	13	11	95	4	472	-	4,106	1,682	25-100
1992	522	1	2	867	167	174	462	46	3	10	77	630	171	91	600	20	11	23	5	237	-	4,119	1,962	25-100
1993	373	1	3	923	139	157	499	44	12	9	70	541	248	83	547	16	8	23	-	-	-	3,696	1,644	25-100
1994	355	0	3	996	141	136	313	37	7	6	49	804	324	91	649	18	10	6	-	-	-	3,945	1,276	25-100
1995	260	0	1	839	128	146	303	28	9	3	48	790	295	83	588	10	9	5	2	83	-	3,629	1,060	-
1996	292	0	2	787	131	118	243	26	7	2	44	685	183	77	427	13	7	-	0	92	-	3,136	1,123	-
1997	229	0	2	630	111	97	59	15	4	1	45	570	142	93	296	8	4	-	1	58	-	2,364	827	-
1998	157	0	2	740	131	119	46	10	5	1	48	624	123	78	283	8	4	6	0	11	-	2,395	1,210	-
1999	152	0	2	811	103	111	35	11	5	1	62	515	150	53	199	11	6	0	0	19	-	2,247	1,032	-
2000	153	0	2	1,176	124	73	11	24	9	5	95	621	219	78	274	11	7	8	0	21	-	2,912	1,269	-
2001	148	0	2	1,267	114	74	14	25	7	6	126	730	184	53	251	11	13	0	0	43	-	3,069	1,180	-
2002	148	0	2	1,019	118	90	7	20	8	5	93	682	161	81	191	11	9	0	0	9	-	2,654	1,039	-
2003	141	0	3	1,071	107	99	11	15	10	4	78	551	89	56	192	13	9	0	0	9	-	2,457	847	-
2004	161	0	3	784	82	111	18	13	7	4	39	489	111	48	245	19	7	0	0	15	-	2,157	686	-
2005	139	0	3	888	82	129	21	9	6	8	47	422	97	52	215	11	13	0	0	15	-	2,156	700	-
2006	137	0	3	932	91	93	17	8	6	2	67	326	80	29	192	13	11	0	0	22	-	2,029	670	-
2007	112	0	2	767	63	93	36	6	10	3	58	85	67	30	171	11	9	0	0	25	-	1,548	475	-
2008	158	0	4	807	73	132	69	8	10	9	71	89	64	21	161	12	9	0	0	26	-	1,721	443	-
2009	126	0	3	595	71	126	44	7	10	8	36	68	54	17	121	4	2	0	0	26	-	1,318	343	-
2010	153	0	3	642	88	147	42	9	13	13	49	99	109	12	180	10	2	0	0	40	-	1,610	393	-
2011	179	0	4	696	89	98	30	20	19	13	44	87	136	10	159	11	7	0	0	28	-	1,629	421	-
2012	126	0	1	696	82	50	20	21	9	12	64	88	58	9	124	10	8	0	0	33	-	1,411	403	-
2013	136	0	5	475	78	125	29	10	4	11	46	103	83	6	123	11	4	0	0	47	-	1,296	306	-
Average																								
2008-2012	148	0	3	687	81	111	41	13	12	11	53	86	84	14	149	9	5	0	0	31	-	1,538	401	-
2003-2012	143	0	3	788	83	108	31	12	10	7	55	230	86	28	176	11	8	0	0	24	-	1,804	538	-

Key:

1. Includes estimates of some local sales, and, prior to 1984, by-catch.
2. Before 1966, sea trout and sea charr included (5% of total).
3. Figures from 1991 to 2000 do not include catches taken in the recreational (rod) fishery.
4 From 1990, catch includes fish ranched for both commercial and angling purposes.
5. Improved reporting of rod catches in 1994 and data derived from carcase tagging and log books from 2002.
6. Catch on River Foyle allocated 50% Ireland and 50% N. Ireland.
7. Angling catch (derived from carcase tagging and log books) first included in 2002.
8. Data for France include some unreported catches.
9. Weights estimated from mean weight of fish caught in Asturias (80-90% of Spanish catch).
10. Between 1991 & 1999, there was only a research fishery at Faroes. In 1997 & 1999 no fishery took place; the commercial fishery resumed in 2000, but has not operated since 2001.
11. Includes catches made in the West Greenland area by Norway, Faroes, Sweden and Denmark in 1965-1975.
12. Includes catches in Norwegian Sea by vessels from Denmark, Sweden, Germany, Norway and Finland.
13. No unreported catch estimate available for Canada in 2007 and 2008. Data for Canada in 2009 and 2010 are incomplete. No unreported catch estimate available for Russia since 2008.
14. Estimates refer to season ending in given year.
15. Catches from hatchery-reared smolts released under programmes to mitigate for hydropower development schemes; returning fish unable to spawn in the wild and exploited heavily.

Table 10.1.5.2 Estimates of unreported catches by various methods, in tonnes by country within national EEZs in the Northeast Atlantic, North American, and West Greenland Commissions of NASCO, 2013.

Commission Area	Country	Unreported Catch t	Unreported as % of Total North Atlantic Catch (Unreported + Reported)	Unreported as % of Total National Catch (Unreported + Reported)
NEAC	Denmark	6	0.4	36
NEAC	Finland	7	0.4	13
NEAC	Iceland	12	0.8	7
NEAC	Ireland	10	0.6	9
NEAC	Norway	204	12.7	30
NEAC	Sweden	2	0.1	9
NEAC	France	2	0.1	12
NEAC	UK (E & W)	14	0.9	14
NEAC	UK (N.Ireland)	0	0.0	5
NEAC	UK (Scotland)	16	1.0	12
NAC	USA	0	0.0	0
NAC	Canada	24	1.5	15
WGC	West Greenland	10	0.6	18
	Total Unreported Catch *	306	19.1	
	Total Reported Catch of North Atlantic salmon	1,296		

* No unreported catch estimate available for Russia in 2013.
Unreported catch estimates not provided for Spain & St. Pierre et Miquelon

Table 10.1.5.3 Numbers of fish caught and released in rod fisheries along with the % of the total rod catch (released + retained) for countries in the North Atlantic where records are available, 1991–2013. Figures for 2013 are provisional.

Year	Canada [4]		USA		Iceland		Russia [1]		UK (E&W)		UK (Scotland)		Ireland		UK (N Ireland) [2]		Denmark		Norway [3]	
	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch
1991	22,167	28	239	50			3,211	51												
1992	37,803	29	407	67			10,120	73												
1993	44,803	36	507	77			11,246	82	1,448	10										
1994	52,887	43	249	95			12,056	83	3,227	13	6,595	8								
1995	46,029	46	370	100			11,904	84	3,189	20	12,151	14								
1996	52,166	41	542	100	669	2	10,745	73	3,428	20	10,413	15								
1997	50,009	50	333	100	1,558	5	14,823	87	3,132	24	10,965	18								
1998	56,289	53	273	100	2,826	7	12,776	81	4,378	30	13,464	18								
1999	48,720	50	211	100	3,055	10	11,450	77	4,382	42	14,846	28								
2000	64,482	56	0	-	2,918	11	12,914	74	7,470	42	21,072	32								
2001	59,387	55	0	-	3,611	12	16,945	76	6,143	43	27,724	38								
2002	50,924	52	0	-	5,985	18	25,248	80	7,658	50	24,058	42								
2003	53,645	55	0	-	5,361	16	33,862	81	6,425	56	29,170	55								
2004	62,316	57	0	-	7,362	16	24,679	76	13,211	48	46,279	50					255	19		
2005	63,005	62	0	-	9,224	17	23,592	87	11,983	56	46,165	55	2,553	12			606	27		
2006	60,486	62	1	100	8,735	19	33,380	82	10,959	56	47,669	55	5,409	22	302	18	794	65		
2007	41,192	58	3	100	9,691	18	44,341	90	10,917	55	55,660	61	13,125	40	470	16	959	57		
2008	54,887	53	61	100	17,178	20	41,881	86	13,035	55	53,347	62	13,312	37	648	20	2,033	71	5,512	5
2009	52,151	59	0	-	17,514	24			9,096	58	48,418	67	10,265	37	847	21	1,709	53	6,696	6
2010	55,895	53	0	-	21,476	29	14,585	56	15,012	60	78,304	70	15,136	40	823	25	2,512	60	15,041	12
2011	71,358	57	0	-	18,593	32			14,406	62	64,669	73	12,753	39	1,197	36	2,153	55	14,303	12
2012	43,287	57	0	-	9,752	28	4,743	43	11,952	65	63,331	74	11,891	35	5,014	59	2,153	55	18,611	14
2013	59,207	61	0	-	20,675	30	3,732	39	9,302	69	55,243	80	6,993	30	1,507	64	1,932	57	15,953	15
5-yr mean 2008-2012	55,515	56			16,903	26			12,700	60	61,614	69	12,671	38	1,706	32	2,112	59	12,033	10
% change on 5-year mean	+7	+9			+22	+14			-27	+15	-10	+16	-45	-21	-12	+99	-9	-3	+33	+53

Key: [1] Since 2009 data are either unavailable or incomplete, however catch-and-release is understood to have remained at similar high levels as before.

[2] Data for 2006-2009 is for the DCAL area only; the figures from 2010 are a total for UK (N.Ireland).

[3] The statistics were collected on a voluntary basis, the numbers reported must be viewed as a minimum.

[4] Released fish in the kelt fishery of New Brunswick are not included in the totals for Canada.

Table 10.1.8.1 Overview of Atlantic salmon stock status categories used by different countries and organizations.

Canadian categories linked to reference points (as used in NASCO IP)	
Category 1	Rivers below 50% of their Conservation Limit (CL).
Category 2	Rivers between 50% and 100% of their CL.
Category 3	Rivers at or over 100% of their CL.
Canadian reference points for application of the precautionary approach (in development)	
Reference points (RP):	
Limit RP	The stock level below which productivity is sufficiently impaired to cause serious harm to the resource but above the level where the risk of extinction becomes a concern.
Upper stock RP	The stock level threshold below which the removal rate is reduced.
Zones:	
Critical zone	Below the Upper stock RP: Management actions must promote stock growth. Removals by all human sources must be kept to the lowest possible level.
Cautious zone	Between the Upper stock RP and the Limit RP: Management actions should promote stock rebuilding towards the Healthy zone. The removal rate should not exceed the Removal reference.
Healthy zone	Above the Upper stock RP: The removal rate should not exceed the Removal reference.
Stock status classification system in Ireland (as used in NASCO IP)	
> 75% probability of meeting / exceeding CL	Surplus above the CL may be used for a harvest fishery (angling and commercial).
65–75% probability of meeting CL	Catch and release fishing may be permitted.
< 65% probability of meeting CL	No fishery is advised.
Stock status classification system in Norway (as used in NASCO IP)	
Critical or lost	Stocks regarded as lost owing to low spawner numbers, or where genetic integrity of the original population is, or has a high probability of becoming lost owing to persistent extremely high levels of escaped farmed salmon (estimated mean proportion of escaped farmed salmon above 35% in the period 1989–2012).
Very bad	Stocks threatened with loss if the negative influence continues or increases. For example rivers infested with *Gyrodactylus salaris* or populations where genetic integrity can be lost owing to persistent very high levels of escaped farmed salmon (estimated mean proportion of escaped farmed salmon 20–35% in the period 1989–2012).
Bad	Stocks are vulnerable or may become threatened with loss if the negative influence continues or increases. Also applies to rivers with persistently high levels of escaped farmed salmon (estimated mean proportion of escaped farmed salmon 8.7–20 % in the period 1989–2012).
Moderately influenced	Stocks with significantly reduced harvestable surplus, reduced production of juveniles (>10%) and/or too small spawning stocks, or rivers with persistently moderate levels of escaped farmed salmon (estimated proportion of escaped farmed salmon 3.3–8.7 % in the period 1989–2012).
Good	Stocks in the lower risk category or with naturally small populations, or rivers with low levels of escaped farmed salmon (1.6–3.3 % in the period 1989–2012).
Very good	Large stocks. Escaped farmed salmon not observed or observed at very low levels (less than 1.5% in the period 1989–2012).
Stock status classification system in Sweden (as used in NASCO IP)	
Good status	Rivers with averages of 80% or more of expected juvenile salmon density (based on habitat variables, etc) are considered to be of good status.
Intermediate status	Rivers with an average of 50–79% of expected juvenile salmon density are labelled intermediate status.
Poor status	Rivers below 50% of expected juvenile salmon density are labelled poor status.
Stock status classification system in UK (England & Wales) (as used in NASCO IP)	
Not at risk	>95% probability of meeting the Management Objective – i.e. of the stock being above the conservation limit in 4 years out of 5, on average.
Probably not at risk	< 95% but >50% probability of meeting the Management Objective.
Probably at risk	< 50% but >5% probability of meeting the Management Objective.
At risk	< 5% probability of meeting the Management Objective. Also includes recovering rivers that do not yet have CLs.

Stock status classification system in UK (N. Ireland) (as used in NASCO IP)

Category 1	All catchment / tributaries attaining CL and management targets.
Category 2	All catchment / tributaries partially attaining management targets.
Category 3	All catchment / tributaries failing to attain management targets.
Category 4	All catchment / tributaries where stock status is unknown.

Stock status classification system in USA (as used in NASCO IP)

Endangered	The Gulf of Maine Distinct Population Segment includes all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River. This represents roughly 14 major salmon rivers.
Restoration	Historically, salmon occurred in most major watersheds south of the Androscoggin River (Maine) to the Housatonic River in the south (Connecticut). Currently, there are programs to restore self-sustained runs of salmon to three rivers and a legacy programme in one river (the Connecticut).

ICES stock status categories – used by all NASCO jurisdictions

The following precautionary reference points are used by ICES for the provision of catch advice for Atlantic salmon.

Full reproductive capacity	The lower bound of the 90% confidence interval of the current estimate of spawners is above the CL.
At risk of suffering reduced reproductive capacity	The lower bound of the confidence interval is below the CL, but the midpoint is above.
Suffering reduced reproductive capacity	The midpoint of the confidence interval is below the CL.

Table 10.1.8.2 Overview of species categories potentially applicable to Atlantic salmon.

Canadian Species at risk classification (COSEWIC)

The Committee on the Status of Endangered Species in Canada (COSEWIC) identifies species at risk through processes put in place under the federal *Species at Risk Act* (SARA) and similar provincial laws (http://www.cosewic.gc.ca/eng/sct0/assessment_process_e.cfm#tbl2).

Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species that no longer exists in the wild in Canada, but exists elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
Special Concern (SC)	A species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
Data Deficient (DD)	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.
Not At Risk (NAR)	A species that has been evaluated and found to be not at risk of extinction given the current circumstances.

Texel–Faial classification

The Texel–Faial classification is used by OSPAR and applied to regional assemblages rather than individual stocks: http://www.ospar.org/documents/dbase/decrecs/agreements/03-13e_Texel_Faial%20criteria.doc

Global Importance	Global importance of the OSPAR area for a species. Importance on a global scale, of the OSPAR Area, for the species is when a high proportion of a species at any time of the life cycle occurs in the OSPAR Area.
Regional importance	Importance within the OSPAR Area, of the regions for the species where a high proportion of the total population of a species within the OSPAR Area for any part of its life cycle is restricted to a small number of locations in the OSPAR Area.
Rarity	A species is rare if the total population size is small. In case of a species that is sessile or of restricted mobility at any time of its life-cycle, a species is rare if it occurs in a limited number of locations in the OSPAR Area, and in relatively low numbers. In case of a highly mobile species, the total population size will determine rarity.
Sensitivity	A species is "very sensitive" when: (a) it has very low resistance (that is, it is very easily adversely affected by human activity); and/or (b) very low resilience (that is, after an adverse effect from human activity, recovery is likely to be achieved only over a very long period, or is likely not to be achieved at all). A species is "sensitive" when: (a) it has low resistance (that is, it is easily adversely affected by human activity); and/or (b) it has low resilience (that is, after an adverse effect from human activity, recovery is likely to be achieved only over a long period).
Keystone species	A species which has a controlling influence on a community.
Decline	Means an observed or indicated significant decline in numbers, extent or quality (quality refers to life history parameters). The decline may be historical, recent, or current. 'Significant' need not be in a statistical sense.

European Union Habitats Directive

Annex II	Animal and plant species of community interest whose conservation requires the designation of special areas of conservation.
Annex IV	Animal and plant species of community interest in need of strict protection.
Annex V	Animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures.

Convention on the Conservation of European Wildlife and Natural Resources (the Bern Convention)

Appendix/Annex III	Contains species that are in need of protection but may be hunted or otherwise exploited in exceptional instances.

The World Conservation Union (IUCN) – (Red Data Books/Lists and Categories)

Extinct (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historical range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

Extinct in the wild (EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historical range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically endangered (CR)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
Near threatened (NT) -	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least concern (LC)	A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.
Not evaluated (NE)	A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

Table 10.1.8.3 Summary assessment of *S. salar* against the Texel–Faial criteria – OSPAR review 2010.

Criterion	Comments	Evaluation
Global Importance	The results of a river-by-river assessment of the status of the Atlantic salmon in Europe and North America concludes that nearly 90% of the known healthy populations of wild salmon are found in Norway, Iceland, Scotland and Ireland (WWF, 2001). This makes the OSPAR maritime area of global importance for this species.	Qualifies
Regional Importance	In Europe, the historical range of the Atlantic salmon extends from Iceland in the northwest (66°N), to the Barents and Kara Seas in the north-east (70°N, 83°E), and southward along the Atlantic coast, with only minor gaps, to the Minho river, the species present southern limit and boundary between Spain in Portugal (42°N). However, native wild stocks are no longer found in the Elbe and the Rhine (where a successful restoration program is now in progress), or in many rivers draining into the Baltic Sea, which previously had abundant salmon runs. In recent years many Baltic salmon stocks have recovered in response to a lowered exploitation. The species is also severely depressed or extinct in the rivers of France and Spain. As a result salmon has disappeared from large European basins and the species range has generally contracted and fragmented over the last century and a half due to anthropogenic effects (Stradmeyer, 2007). However, there have been recent improvements linked to improved water management with salmon returning for example to the Seine (Perrier et al., 2010).	Qualifies
Rarity	**According to the Texel–Faial Criteria, the total population size determines the rarity of a highly mobile species such as the Atlantic salmon. Despite the fact that the stock is close to its historical minimum in most of the distribution area, Atlantic salmon are still present in many areas.**	Does not qualify
Sensitivity	The Atlantic salmon is known to be highly sensitive to water quality (estuarine and freshwater zones) particularly in relation to eutrophication, chemical contaminants increased sedimentation and temperature (climate change) (OSPAR, 2006). both at the adult stage when migrating up river and at the juvenile stage when growing in nursery zones.	Qualifies – very sensitive
Keystone species	Atlantic Salmon is a cultural icon throughout its North Atlantic range; it is the focus of probably the World's highest profile recreational fishery and is the basis for one of the World's largest aquaculture industries (Stradmeyer, 2007). It is also an indicator of healthy aquatic environments (NASCO website).	Qualifies
Decline	Records of the numbers of salmon returning to monitored rivers indicate that, despite drastic reductions in directed fisheries, there has been at least a threefold reduction in marine survival rates since the early 1970s. The reduction in the numbers returning has been accompanied by a marked decline in the proportion of multi sea-winter fish. Such a change in an age distribution is a classic symptom of a sustained increase in mortality rate, a conclusion which is supported by the current relative scarcity of repeat spawners in the returning populations (IASRB SAG(09)9). Furthermore, changes in age composition result in a shortening of the life cycle and a more precocious sexual maturation age which could be an adaptive strategy to more drastic environmental conditions (Baglinière, pers.comm.). The status of salmon populations in both North America and Europe show a clear geographical pattern, with most populations in the southern areas in severe condition; in the north the populations are generally stable while at intermediate latitudes, populations are declining. While many of the problems could be attributed to the construction of dams, pollution (including acid rain), and total dewatering of streams, along with overfishing, and recently, changing ocean conditions and intensive aquaculture, many declines cannot be fully explained (ICES, 2007).	Qualifies – severely declined

Table 10.1.8.4 Compilation of stock/river status categories compared with the NASCO Rivers Database categories. As categories are defined in different ways, direct alignment is not possible. However, broad comparisons are presented and a tentative categorization based on attainment of CLs or other stock indicators is provided in the final two columns.

NASCO criteria	Canada PA	Canada Imp. Plan	Ireland	Norway	Sweden	UK (E&W)	UK (N. Ire)	ICES		CL or other stock indicator	Tentative categories linked with CL or other stock indicator
Lost				Critical or lost						0% of CL	Lost
										<25% of CL	Critical condition
				Very Bad						>25% but <50% of CL	Threatened with loss
Threatened with loss	Critical zone	< 50% of CL		Bad	Bad status	At risk		Suffering reduced reproductive capacity.			
	Cautious zone	50% to 100% of CL	Closure <65% CL	Moderately influenced		Probably at risk	Failing to attain MTs	At risk of suffering reduced reproductive capacity		>50% but <75%	Not threatened with loss but actions should be taken to stop or reduce exploitation and rebuild
			C&R 65% to 100% CL		Intermediate status	Probably not at risk	Partially attaining targets			>75% but<100%	Not threatened with loss, but effort should be managed with caution or C&R only
Not threatened with loss	Healthy zone	> 100% of CL	Harvest >100 % CL	Good	Good status	Not at risk	Attaining CLs and MTs	Full reproductive capacity		approx 100 %	Not threatened with loss; effort or harvest fisheries should be managed with caution
				Very Good						>100%	Not Threatened - harvest can proceed in line with identified surplus
Unknown						Rivers with no CLs	Stock status unknown				
Not present but potential											
Restored											
Maintained											

Table 10.1.8.5 Compilation of species status categories compared with the NASCO Rivers Database categories. As categories are defined in different ways, direct alignment is not always possible. However, relative alignments are suggested.

NASCO criteria	Canada COSEWIC	USA ESA	IUCN	TEXEL FAIAL	EU Habitats Directive	Bern Convention
Lost	Extinct (X) Extirpated (XT)		Extinct (EX) Extinct in the wild (EW)			
Restored		Restoration				
			Critically endangered (CR)			
	Endangered (E)	Endangered	Endangered (EN)		Annex IV - Species needing strict protection	
Threatened with loss	Threatened (T)		Vulnerable (VU)	Decline	Annex V - Species where exploitation needs to be controlled	Annex III
	Special Concern (SC)		Near threatened (NT)	Very sensitive		
Not threatened with loss	Not At Risk (NAR)		Least Concern (LC)	Rare Regional importance Global importance: Keynote	Annex II - species needing SACs	
Unknown	Data Deficient (DD)		Data Deficient (DD) Not evaluated (NE)			
Not present but potential						
Maintained						

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Table 10.1.10.1 Summary of Atlantic salmon tagged and marked in 2013.

		Primary Tag or Mark				
Country	Origin	Microtag	External mark[2]	Adipose clip	Other Internal[1]	Total
Canada	Hatchery Adult	0	1,488	68	268	1,824
	Hatchery Juvenile	0	152	106,310	30	106,492
	Wild Adult	0	2,568	0	64	2,632
	Wild Juvenile	0	10,677	9,286	457	20,420
	Total	**0**	**14,885**	**115,664**	**819**	**131,368**
Denmark	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	188,450		169,600	0	358,050
	Wild Adult	0	0	0	0	0
	Wild Juvenile	0	0	0	0	0
	Total	**188,450**	**0**	**169,600**	**0**	**358,050**
France	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile[3]	0	360	534,500	0	534,860
	Wild Adult[3]	2,568	0	0	413	2,981
	Wild Juvenile	183	0	0	0	183
	Total	**2,751**	**360**	**534,500**	**413**	**538,024**
Iceland	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	43,329	0	0	0	43,329
	Wild Adult		255	0	0	255
	Wild Juvenile	4,928	0	0	0	4,928
	Total	**48,257**	**255**	**0**	**0**	**48,512**
Ireland	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	223,463	0	7,459	0	230,922
	Wild Adult		0	0	0	0
	Wild Juvenile		0	0	0	0
	Total	**223,463**	**0**	**7,459**	**0**	**230,922**
Norway	Hatchery Adult	0	9	0	0	9
	Hatchery Juvenile	55,957	9,879	0	0	65,836
	Wild Adult	0	325	0	0	325
	Wild Juvenile	1,162	1,501	0	0	2,663
	Total	**57,119**	**11,714**	**0**	**0**	**68,833**
Russia	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0		1,509,868	0	1,509,868
	Wild Adult	0	1,406		0	1,406
	Wild Juvenile	0	0	0	0	0
	Total	**0**	**1,406**	**1,509,868**	**0**	**1,511,274**
Spain	Hatchery Adult	0	0	0	0	**0**
	Hatchery Juvenile	0	65,065	0	0	**65,065**
	Wild Adult	0	0	0	0	**0**
	Wild Juvenile	0	0	0	0	**0**
	Total	**0**	**65,065**	**0**	**0**	**65,065**
Sweden	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile[4]	0	4000	155,544	0	159,544
	Wild Adult	0	0		0	0
	Wild Juvenile	0	500		0	500
	Total	**0**	**4,500**	**155,544**	**0**	**160,044**
UK (England & Wales)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	0	119,125	0	119,125
	Wild Adult	0	276	0	103	379
	Wild Juvenile	7,942	0	10,733	0	18,675
	Total	**7,942**	**276**	**129,858**	**103**	**138,179**
UK (N. Ireland)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	20,237	0	60,384	0	80,621
	Wild Adult	0	0	0	0	0
	Wild Juvenile		0	0	0	0
	Total	**20,237**	**0**	**60,384**	**0**	**80,621**
UK (Scotland)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	0	102,863	0	102,863
	Wild Adult	0	462	0	99	561
	Wild Juvenile	1989	0	0	3,489	5,478
	Total	**1,989**	**462**	**102,863**	**3,588**	**108,902**
USA	Hatchery Adult	0	2,668	0	1,150	3,818
	Hatchery Juvenile	0	0	111,886	1,493	113,379
	Wild Adult	0	0	0	0	0
	Wild Juvenile	0	0	0	175	175
	Total	**0**	**2,668**	**111,886**	**2,818**	**117,372**
All Countries	Hatchery Adult	0	4,165	68	1,418	5,651
	Hatchery Juvenile	531,436	79,456	2,877,539	1,523	3,489,954
	Wild Adult	2,568	5,292	0	679	8,539
	Wild Juvenile	16,204	12,678	20,019	4,121	53,022
	Total	**550,208**	**101,591**	**2,897,626**	**7,741**	**3,557,166**

[1] Includes other internal tags (PIT, ultrasonic, radio, DST, etc.)
[2] Includes Carlin, spaghetti, streamers, VIE etc.
[3] Includes external dye mark.
[4] The 4000 external tagged hatchery juveiles also adipose finclipped

Table 10.1.11.1 Tonnes of mackerel and herring, number of salmon caught, and number of salmon per 1000 t mackerel and herring from landings where salmon was reported as bycatch, 2010–2013.

Year	Tonnes mackerel and herring	No salmon/ 1000 t mackerel and herring	No salmon caught	Additional salmon samples	Total number of samples
2010	35403	4.8	169	1	170
2011	40048	6.2	249	8	257
2012	8536	5.6	48	1	49
2013	23907	4.7	112	2	114
Total	107894	5.4	578	12	590

Table 10.1.11.2 Tonnes of mackerel and herring screened on-board fishing vessels by the Icelandic Directorate of Fishery inspectors, proportion mackerel in catches, and number of salmon per 1000 t mackerel and herring, 2010–2013.

Year	Tonnes Screened	Proportions Mackerel	No salmon/ 1000 t mackerel and herring	No salmon
2010				
2011	24562	67	5.5	134
2012	28813	62	0.0	0
2013	17138		0.9	15
Total	70513		2.1	149

Table 10.1.11.3 Number and percentage of salmon caught as bycatch in mackerel and herring fisheries in Iceland 2010–2013, divided by length group into salmon life stages.

Year	Post-smolt 20-49 cm Number	%	1SW 50-69 cm Number	%	MSW 70-100 cm Number	%	Total Number	%	No length data
2010	16	9.4	125	73.5	29	17.1	170	100	0
2011	47	18.6	156	61.7	50	19.8	253	100	4
2012	3	6.3	37	77.1	8	16.7	48	100	1
2013	21	18.4	85	74.6	8	7.0	114	100	10
Total	87	14.9	403	68.9	95	16.2	585		15

Table 10.1.11.4 Total catches screened (mostly mackerel) during the IESSNS surveys, number of salmon caught, and number of salmon per 1000 t of catch. The number of salmon per 1000 t in the row "Total" is the weighted average of the years.

Year	Total catch (t)	No. salmon	No. salmon/1000 t	Average length (cm)
2010	212.6	10	47.0	54.7
2011	45.0	2	44.4	66.2
2012	214.9	26	121.0	45.1
2013	288.4	40	138.7	33.8
Total	760.9	78	102.5	

Table 10.1.12.1 The probability of meeting each management objective individually and of meeting all seven objectives simultaneously for fishing years 2012–2014, assuming zero harvest under the existing and the proposed new US management objectives. The original assessment was reported by ICES (2012c) and the updated assessment was based on a re-analysis of catch options with the 2012 input data and the proposed new USA management objective.

	LAB	NFLD	QC	GULF	SF	US	SNEAC MSW	Simultaneous
Existing Management Objective for US stock complex								
2012	0.45	0.86	0.71	0.50	0.15	0.89	0.92	0.05
2013	0.48	0.78	0.73	0.50	0.25	0.75	0.86	0.07
2014	0.56	0.78	0.75	0.55	0.20	0.86	0.87	0.08
Proposed new Management Objective for US stock complex								
2012	0.45	0.86	0.71	0.50	0.15	0.66	0.92	0.05
2013	0.48	0.78	0.73	0.50	0.25	0.50	0.86	0.06
2014	0.56	0.78	0.75	0.55	0.20	0.70	0.87	0.07

Annex 1 Glossary of acronyms and abbreviations

1SW *(One-Sea-Winter).* Maiden adult salmon that has spent one winter at sea.
2SW *(Two-Sea-Winter).* Maiden adult salmon that has spent two winters at sea.
ACOM *(Advisory Committee)* of ICES. The Committee works on the basis of scientific assessment prepared in the ICES expert groups. The advisory process includes peer review of the assessment before it can be used as the basis for advice. The Advisory Committee has one member from each member country under the direction of an independent chair appointed by the Council.
BCI *(Bayesian Credible Interval).* The Bayesian equivalent of a confidence interval. If the 90% BCI for a parameter A is 10 to 20, there is a 90% probability that A falls between 10 and 20.
BHSRA *(Bayesian Hierarchical Stock and Recruitment Approach)*. Models for the analysis of a group of related stock–recruit datasets. Hierarchical modelling is a statistical technique that allows the modelling of the dependence among parameters that are related or connected through the use of a hierarchical model structure. Hierarchical models can be used to combine data from several independent sources.
C&R *(Catch and Release).* Catch and release is a practice within recreational fishing intended as a technique of conservation. After capture, the fish are unhooked and returned to the water before experiencing serious exhaustion or injury. Using barbless hooks, it is often possible to release the fish without removing it from the water (a slack line is frequently sufficient).
CL, i.e. S_{lim} *(Conservation Limit).* Demarcation of undesirable stock levels or levels of fishing activity; the ultimate objective when managing stocks and regulating fisheries will be to ensure that there is a high probability that undesirable levels are avoided.
COSEWIC *(Committee on the Status of Endangered Wildlife in Canada).* COSEWIC is the organization that assesses the status of wild species, subspecies, varieties, or other important units of biological diversity, considered to be at risk of extinction in Canada. COSEWIC uses scientific, Aboriginal traditional and community knowledge provided by experts from governments, academia and other organizations. Summaries of assessments on Atlantic salmon are currently available to the public on the COSEWIC website (www.cosewic.gc.ca).
Cpue *(Catch Per Unit of Effort).* A derived quantity obtained from the independent values of catch and effort.
CWT *(Coded Wire Tag).* The CWT is a length of magnetized stainless steel wire 0.25 mm in diameter. The tag is marked with rows of numbers denoting specific batch or individual codes. Tags are cut from rolls of wire by an injector that hypodermically implants them into suitable tissue. The standard length of a tag is 1.1 mm.
DFO *(Department of Fisheries and Oceans).* DFO and its Special Operating Agency, the Canadian Coast Guard, deliver programs and services that support sustainable use and development of Canada's waterways and aquatic resources.
DNA *(Deoxyribonucleic Acid).* DNA is a nucleic acid that contains the genetic instructions used in the development and functioning of all known living organisms (with the exception of RNA- Ribonucleic Acid viruses). The main role of DNA molecules is the long-term storage of information. DNA is often compared to a set of blueprints, like a recipe or a code, since it contains the instructions needed to construct other components of cells, such as proteins and RNA molecules.
DST *(Data Storage Tag).* A miniature data logger with sensors including salinity, temperature, and depth that is attached to fish and other marine animals.
ECOKNOWS *(Effective use of Ecosystems and biological Knowledge in fisheries).* The general aim of the ECOKNOWS project is to improve knowledge in fisheries science and management. The lack of appropriate calculus methods and fear of statistical over partitioning in calculations, because of the many biological and environmental influences on stocks, has limited reality in fisheries models. This reduces the biological credibility perceived by many stakeholders. ECOKNOWS will solve this technical estimation problem by using an up-to-date methodology that supports more effective use of data. The models will include important knowledge of biological processes.
ENPI CBC *(European Neighbourhood and Partnership Instrument Cross-Border Cooperation).* ENPI CBC is one of the financing instruments of the European Union. The ENPI programmes are being implemented on the external borders of the EU. It is designed to target sustainable development and approximation to EU policies and standards; supporting the agreed priorities in the European Neighbourhood Policy Action Plans, as well as the Strategic Partnership with Russia.
FWI *(Framework of Indicators).* The FWI is a tool used to indicate if any significant change in the status of stocks used to inform the previously provided multi-annual management advice has occurred.
GRAASP *(Genetically based Regional Assignment of Atlantic Salmon Protocol).* GRAASP was developed and validated by twelve European genetic research laboratories. Existing and new genetic data were calibrated and integrated in a purpose built electronic database to create the assignment baseline. The unique database created initially encompassed 32 002 individuals from 588 rivers. The baseline data, based on a suite of 14 microsatellite loci, were used to identify the natural evolutionary regional stock groupings for assignment.
ICPR *(The International Commission for the Protection of the River Rhine).* ICPR coordinates the ecological rehabilitation programme involving all countries bordering the river Rhine. This programme was initiated in response to catastrophic river pollution in Switzerland in 1986 which killed hundreds of thousands of fish. The programme aims to

bring about significant ecological improvement of the Rhine and its tributaries enabling the re-establishment of migratory fish species such as salmon.

ISAV *(Infectious Salmon Anemia Virus).* ISAV is a highly infectious disease of Atlantic salmon caused by an enveloped virus.

LE *(Lagged Eggs)*. The summation of lagged eggs from 1 and 2 sea winter fish is used for the first calculation of PFA.

LMN *(Labrador Métis Nation).* LMN is one of four subsistence fisheries harvesting salmonids in Labrador. LMN members are fishing in southern Labrador from Fish Cove Point to Cape St Charles.

MSY *(Maximum Sustainable Yield).* The largest average annual catch that may be taken from a stock continuously without affecting the catch of future years; a constant long-term MSY is not a reality in most fisheries, where stock sizes vary with the strength of year classes moving through the fishery.

MSW *(Multi-Sea-Winter).* A MSW salmon is an adult salmon which has spent two or more winters at sea and may be a repeat spawner.

NG *(Nunatsiavut Government).* NG is one of four subsistence fisheries harvesting salmonids in Labrador. NG members are fishing in the northern Labrador communities.

NSERC *(Natural Sciences and Engineering Research Council of Canada)*. NSERC is a Canadian government agency that provides grants for research in the natural sciences and in engineering. Its mandate is to promote and assist research. Council supports a project to develop a standardized genetic database for North America.

OSPAR (*Convention for the Protection of the Marine Environment of the North-East Atlantic*). OSPAR is the mechanism by which fifteen Governments of the west coasts and catchments of Europe, together with the European Community, cooperate to protect the marine environment of the Northeast Atlantic. It started in 1972 with the Oslo Convention against dumping. It was broadened to cover land-based sources and the offshore industry by the Paris Convention of 1974. These two conventions were unified, updated and extended by the 1992 OSPAR Convention. The new annex on biodiversity and ecosystems was adopted in 1998 to cover non-polluting human activities that can adversely affect the sea.

PFA *(Pre-Fishery Abundance).* The numbers of salmon estimated to be alive in the ocean from a particular stock at a specified time. In the previous version of the stock complex Bayesian PFA forecast model two productivity parameters are calculated, for the *maturing* (PFAm) and *non-maturing* (PFAnm) components of the PFA**.** In the updated version only one productivity parameter is calculated, and used to calculate total PFA, which is then split into PFAm and PFAnm based upon the *proportion of PFAm* (p.PFAm).

PGA *(The Probabilistic-based Genetic Assignment model).* An approach to partition the harvest of mixed-stock fisheries into their finer origin parts. PGA uses Monte Carlo sampling to partition the reported and unreported catch estimates to continent, country and within country levels.

PGCCDBS *The Planning Group on Commercial Catches, Discards and Biological Sampling*.

PGNAPES *(Planning Group on Northeast Atlantic Pelagic Ecosystem Surveys)*. PGNAPES coordinates international pelagic surveys in the Norwegian Sea and to the West of the British Isles, directed in particular towards Norwegian Spring-spawning Herring and Blue Whiting. In addition, these surveys collect environmental information. The work in the group has progressed as planned.

PIT *(Passive Integrated Transponder).* PIT tags use radio frequency identification technology. PIT tags lack an internal power source. They are energized on encountering an electromagnetic field emitted from a transceiver. The tag's unique identity code is programmed into the microchip's nonvolatile memory.

PSAT (*Pop-up Satellite Archival Tags*). Used to track movements of large, migratory, marine animals. A PSAT is an archival tag (or data logger) that is equipped with a means to transmit the data via satellite.

PSU *(Practical Salinity Units).* PSU are used to describe salinity: a salinity of 35‰ equals 35 PSU.

Q Areas for which the Ministère des Ressources naturelles et de la Faune manages the salmon fisheries in Québec.

RR model *(Run–reconstruction model).* RR model is used to estimate PFA and national CLs.

RVS *(red vent syndrome).* This condition has been noted since 2005, and has been linked to the presence of a nematode worm, *Anisakis simplex*. This is a common parasite of marine fish and is also found in migratory species. The larval nematode stages in fish are usually found spirally coiled on the mesenteries, internal organs and less frequently in the somatic muscle of host fish.

SALSEA (*Salmon at Sea*). SALSEA is an international programme of cooperative research designed to improve understanding of the migration and distribution of salmon at sea in relation to feeding opportunities and predation. It differentiates between tasks which can be achieved through enhanced coordination of existing ongoing research, and those involving new research for which funding is required.

SARA *(Species At Risk Act).* SARA is a piece of Canadian federal legislation which became law in Canada on December 12, 2002. It is designed to meet one of Canada's key commitments under the International Convention on Biological Diversity. The goal of the Act is to protect endangered or threatened organisms and their habitats. It also manages species which are not yet threatened, but whose existence or habitat is in jeopardy. SARA defines a method to determine the steps that need to be taken in order to help protect existing relatively healthy environments, as well as recover threatened habitats. It identifies ways in which governments, organizations, and individuals can work together to preserve species at risk and establishes penalties for failure to obey the law.

SCICOM *(Science Committee)* of ICES. SCICOM is authorized to communicate to third-parties on behalf of the Council on science strategic matters and is free to institute structures and processes to ensure that inter alia science programmes, regional considerations, science disciplines, and publications are appropriately considered.

SER *(spawning escapement reserve).* The CL increased to take account of natural mortality between the recruitment date (assumed to be 1st January) and the date of return to homewaters.

SFA *(Salmon Fishing Areas).* Areas for which the Department of Fisheries and Oceans (DFO) Canada manages the salmon fisheries.

SGBICEPS *(The Study Group on the Identification of Biological Characteristics For Use As Predictors Of Salmon Abundance).* The ICES study group established to complete a review of the available information on the life-history strategies of salmon and changes in the biological characteristics of the fish in relation to key environmental variables.

SGBYSAL *(Study Group on the Bycatch of Salmon in Pelagic Trawl Fisheries).* The ICES study group that was established in 2005 to study Atlantic salmon distribution at sea and fisheries for other species with a potential to intercept salmon.

SGEFISSA (*Study Group on Establishing a Framework of Indicators of Salmon Stock Abundance*). SGEFISSA is a study group established by ICES and met in November 2006.

SGERAAS (*Study Group on Effectiveness of Recovery Actions for Atlantic Salmon*). SGERAAS is the previous acronym for WGERAAS (*Working Group on Effectiveness of Recovery Actions for Atlantic Salmon*).

SGSSAFE (*Study Group on Salmon Stock Assessment and Forecasting*). The study group established to work on the development of new and alternative models for forecasting Atlantic salmon abundance and for the provision of catch advice.

S_{lim}, i.e. CL *(Conservation Limit).* Demarcation of undesirable stock levels or levels of fishing activity; the ultimate objective when managing stocks and regulating fisheries will be to ensure that there is a high probability that the undesirable levels are avoided.

SSGEF *(SCICOM Steering Group on Understanding Ecosystem Functioning).* SSGEF is one of five Steering Groups of SCICOM (Science Committee of ICES). Chair: Graham Pierce (UK); term of office: January 2012–December 2014.

SST (*Sea surface temperature*). SST is the water temperature close to the surface. In practical terms, the exact meaning of surface varies according to the measurement method used. A satellite infrared radiometer indirectly measures the temperature of a very thin layer of about 10 micrometres thick of the ocean which leads to the phrase skin temperature. A microwave instrument measures subskin temperature at about 1 mm. A thermometer attached to a moored or drifting buoy in the ocean would measure the temperature at a specific depth, (e.g. at one meter below the sea surface). The measurements routinely made from ships are often from the engine water in-takes and may be at various depths in the upper 20 m of the ocean. In fact, this temperature is often called sea surface temperature, or foundation temperature.

SVC *(Spring Viraemia of Carp)*. SVC is a contagious and potentially fatal viral disease affecting fish. As its name implies, SVC may be seen in carp in spring. However, SVC may also be seen in other seasons (especially in autumn) and in other fish species including goldfish and the European wells catfish. Until recently, SVC had only been reported in Europe and the Middle East. The first cases of SVC reported in the United States were in spring 2002 in cultivated ornamental common carp (Koi) and wild common carp. The number of North American fish species susceptible to SVC is not yet known.

TAC *(Total Allowable Catch).* TAC is the quantity of fish that can be taken from each stock each year.

WFD *(Water Framework Directive).* Directive 2000/60/EC (WFD) aims to protect and enhance the water environment, updates all existing relevant European legislation, and promotes a new approach to water management through river-based planning. The Directive requires the development of River Basin Management Plans (RBMP) and Programmes of Measures (PoM) with the aim of achieving Good Ecological Status or, for artificial or more modified waters, Good Ecological Potential.

WGBAST *(Assessment Working Group on Baltic Salmon and Trout*). The Assessment Working Group on Baltic Salmon and Trout assesses the status and trends of salmon and sea trout stocks in the Baltic Sea and provides annual catch advice on salmon. WGBAST last took place in Tallinn, Estonia, during April 2013, chaired by Tapani Pakarinen (Finland).

WGERAAS *(Working Group on Effectiveness of Recovery Actions for Atlantic Salmon).* The task of the working group is to provide a review of examples of successes and failures in wild salmon restoration and rehabilitation and develop a classification of activities which could be recommended under various conditions or threats to the persistence of populations. The Working Group held its first meeting in Belfast in February 2013. The next meeting is scheduled for May 2014 at ICES in Copenhagen.

WGF *(West Greenland Fishery).* Regulatory measures for the WGF have been agreed by the West Greenland Commission of NASCO for most years since NASCO's establishment. These have resulted in greatly reduced allowable catches in the WGF, reflecting declining abundance of the salmon stocks in the area.

WGRECORDS *(Working Group on the Science Requirements to Support Conservation, Restoration and Management of Diadromous Species)*. WGRECORS was reconstituted as a Working Group from the Transition Group on the Science Requirements to Support Conservation, Restoration and Management of Diadromous Species (TGRECORDS).

WKADS *(Workshop on Age Determination of Salmon).* WKADS took place in Galway, Ireland, January 18th to 20th 2011, with the objectives of reviewing, assessing, documenting and making recommendations on current methods of ageing Atlantic salmon. The Workshop focused primarily on digital scale reading to measure age and growth with a view to standardization.

WKADS2 (*A second Workshop on Age Determination of Salmon*). Took place from September 4th to 6th, 2012 in Derry ~ Londonderry, Northern Ireland to addressed recommendations made at the previous WKADS meeting (2011) (ICES CM 2011/ACOM:44) to review, assess, document and make recommendations for ageing and growth estimations of Atlantic salmon using digital scale reading, with a view to standardization. Available tools for measurement, quality control and implementation of inter-laboratory QC were considered.

WKDUHSTI (*Workshop on the Development and Use of Historical Salmon Tagging Information from Oceanic Areas*). This workshop, established by ICES, was held in February 2007.

WKSHINI (*Workshop on Salmon historical information-new investigations from old tagging data*). This workshop met from 18–20 September 2008 in Halifax, Canada.

WKLUSTRE *(Workshop on Learning from Salmon Tagging Records).* This ICES Work-shop established to complete compilation of available data and analyses of the resulting distributions of salmon at sea.

This glossary has been extracted from various sources. It was initially based on the EU SALMODEL report (Crozier *et al.*, 2003), but has subsequently been updated at successive Working Group meetings.

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ECOREGION **North Atlantic**

STOCK **Atlantic salmon from the Northeast Atlantic**

Advice for 2014

The NASCO Framework of Indicators for North East Atlantic stocks for 2013 was run in January 2014, and did not indicate the need for a revised analysis of catch options. Thus, no new management advice is provided for 2014. The most recent multi-year advice for the North East Atlantic Commission was provided by ICES (2013a). In that assessment, there were no catch options for the Faroes fishery that would allow all stock complexes to achieve their conservation limits (CLs) with a greater than 95% probability in any of the seasons 2013/14 to 2015/16. In the absence of specific management objectives, ICES advised that there were no mixed-stock fishery options on the NEAC complexes at Faroes in 2013 to 2016. The results from the exploratory assessment conducted by ICES in 2013 based on smaller management units (countries) were in line with this advice.

While stocks remain in a depleted state and in the absence of a fishery at Faroes, particular care should be taken to ensure that fisheries in homewaters are managed to protect stocks that are below their CLs.

Stock status

National stocks within the NEAC area are combined into two stock groupings for the provision of management advice for the distant-water fisheries at West Greenland and Faroes. The northern group (northern NEAC) consists of: Russia, Finland, Norway, Sweden, and the northeast regions of Iceland. The southern group (southern NEAC) consists of: UK (Scotland), UK (England and Wales), UK (N. Ireland), Ireland, France, and the southwest regions of Iceland.

Recruitment, expressed as pre-fishery abundance (PFA; split by maturing and non-maturing 1SW salmon, at 1 January of the first winter at sea) is estimated by stock complex (northern NEAC and southern NEAC) and interpreted relative to the spawner escapement reserve (SER) (Figure 10.2.1). SERs are the conservation limits (CLs; expressed in terms of spawner numbers) increased to take account of natural mortality (M = 0.03 per month) between 1 January of the first winter at sea and return time to homewaters for each of the maturing (6 to 9 months) and non-maturing (16 to 21 months) 1SW salmon from the northern NEAC and southern NEAC stock complexes.

Recruitment (PFA) of maturing 1SW salmon and of non-maturing 1SW salmon for northern NEAC shows a general decline over the time period (Figure 10.2.1), the decline being more marked in the maturing 1SW stock. Both stock complexes have, however, been at full reproductive capacity (i.e. >95% probability of achieving CLs) prior to the commencement of distant-water fisheries throughout the time-series. Recruitment of maturing 1SW and non-maturing 1SW salmon for southern NEAC also demonstrate broadly similar declining trends over the time period (Figure 10.2.1). Both stock complexes were at full reproductive capacity prior to the commencement of distant-water fisheries throughout the early part of the time-series. Since the mid-1990s, however, the non-maturing 1SW stock has been at risk of suffering reduced reproductive capacity in approximately 50% of the assessment years. The maturing 1SW stock, on the other hand, was first assessed as being at risk of suffering reduced reproductive capacity in 2009. This is broadly consistent with the general pattern of decline in marine survival in most monitored stocks in the area.

Based on the NEAC run–reconstruction model, three of the NEAC stock complexes (both northern NEAC stock complexes and the southern NEAC maturing 1SW stock) were considered to be at full reproductive capacity, prior to the commencement of distant-water fisheries, in the latest available PFA year. However, the southern NEAC non-maturing 1SW stock was considered to be at risk of suffering reduced reproductive capacity, prior to the commencement of distant-water fisheries, in the latest available PFA year.

For the northern NEAC stock complexes, 1SW spawners have been at full reproductive capacity throughout the time-series (Figure 10.2.1). In contrast, MSW spawners, while generally remaining at full reproductive capacity, have spent limited periods either at risk of suffering, or suffering, reduced reproductive capacity. Both the 1SW and MSW stock complexes were at full reproductive capacity in 2013. The 1SW spawning stock in the southern NEAC stock complex has been at risk of suffering, or suffering, reduced reproductive capacity for most of the time-series (Figure 10.2.1). In contrast, the MSW stock was at full reproductive capacity for most of the time-series until 1997. After this point, however, the stock has generally been at risk of suffering, or suffering, reduced reproductive capacity. Of the two southern NEAC stock complexes only the 1SW complex was at full reproductive capacity in 2013.

Estimated exploitation rates have generally been decreasing over the time period in the northern and southern NEAC areas (Figure 10.2.2). Despite management measures aimed at reducing exploitation in recent years, there has been little improvement in the status of stocks over time. This is mainly a consequence of continuing poor survival in the marine environment.

Management plans

The North Atlantic Salmon Conservation Organization (NASCO) has adopted an Action Plan for Application of the Precautionary Approach which stipulates that management measures should be aimed at maintaining all stocks above their conservation limits by the use of management targets. Conservation limits (CLs) for North Atlantic salmon stock complexes have been defined by ICES as the level of stock (number of spawners) that will achieve long-term average maximum sustainable yield (MSY). NASCO has adopted the region-specific CLs as limit reference points (S_{lim}); having populations fall below these limits should be avoided with high probability. Advice for the Faroes fishery (both 1SW and MSW) is based upon all NEAC area stocks. The advice for the West Greenland fishery is based upon the southern NEAC non-maturing 1SW stock.

Biology

Atlantic salmon (*Salmo salar*) is an anadromous species found in rivers of countries bordering the North Atlantic. In the Northeast Atlantic area, their current distribution extends from northern Portugal to the Pechora River in Northwest Russia and Iceland. Juveniles emigrate to the ocean at ages of one to eight years (dependent on latitude) and generally return after one or two years at sea. Long-distance migrations to ocean feeding grounds take place, with adult salmon from the Northeast Atlantic stocks being exploited at both West Greenland and the Faroes.

Environmental influence on the stock

Environmental conditions in both freshwater and marine environments have a marked effect on the status of salmon stocks. Across the North Atlantic, a range of problems in the freshwater environment play a significant role in explaining the poor status of stocks. In many cases, factors such as river damming and habitat deterioration have had a devastating effect on freshwater environmental conditions. In the marine environment, return rates of adult salmon have declined through the 1980s and are now at the lowest levels in the time-series for some stocks, even after closure of marine fisheries. Climatic factors modifying ecosystem conditions and predator fields of salmon at sea are considered to be important contributory factors to lower productivity, which is expressed almost entirely in terms of lower marine survival.

The fisheries

No fishery for salmon has been prosecuted at Faroes since 2000. No significant changes in gear type used were reported in the NEAC area in 2013. The NEAC area has seen a general reduction in catches since the 1980s (Figure 10.2.3; Table 10.2.1). This reflects the decline in fishing effort as a consequence of management measures, as well as a reduction in the size of stocks. The provisional total nominal catch for 2013 was 778 t in northern NEAC and 329 t in southern NEAC; the total NEAC area catch (1107 t) is the lowest in the time-series. The catch in the southern area, which represented around two-thirds of the total NEAC catch in the early 1970s, has been consistently lower than that in the northern area since 1999 (Figure 10.2.3).

1SW salmon constituted 62% of the total catch in the northern NEAC area in 2013, compared with 54% for the southern area (Figure 10.2.4). There has been an overall decline in the percentage of 1SW fish in northern NEAC catches in recent years, when greater variability between countries has also been apparent. The percentage of 1SW fish in southern NEAC has remained reasonably consistent over the time-series, although with considerable variability among individual countries (Figure 10.2.4).

The contribution of escaped farmed salmon in catches in the NEAC area in 2013 was again generally low in most countries, with the exception of Norway, Iceland, and Sweden, and similar to the values that have been reported in previous years. The estimated proportion of farmed salmon in Norwegian angling catches was the lowest on record (3.5%), whereas the proportion in samples taken from Norwegian rivers in the autumn was higher than in most recent years (21%). The number of salmon provisionally reported to have escaped from Norwegian farms in 2013 was 198 000, up from the previous year (38 000).

ICES reviewed the information on bycatch of Atlantic salmon in pelagic fisheries, primarily for mackerel, and concluded that estimates of total salmon bycatch were highly uncertain. ICES identified a number of tasks that could be undertaken to provide more reliable estimates and recommended that further investigations would be informative (see Section 10.1.11).

Effects of the fisheries on the ecosystem

The current salmon fishery probably has no, or only minor, influence on the marine ecosystem. However, the exploitation rate on salmon may affect the riverine ecosystem through changes in species composition. There is limited knowledge on the magnitude of any such effects.

Quality considerations

Uncertainties in input variables to the stock status and stock forecast models are incorporated in the assessment. Provisional catch data for 2012 were updated, where appropriate, and the assessment extended to include data for 2013.

Recommendations in relation to data collection for assessment needs for Atlantic salmon were provided in the report of the ICES Workshop on Eel and Salmon Data Collection Framework WKESDCF (ICES, 2012c) and discussions have continued with the European Commission in relation to future monitoring requirements.

Scientific basis

Assessment type	Run–reconstruction models and Bayesian forecasts, taking into account uncertainties in data and process error. Results presented in a risk analysis framework.
Input data	Nominal catches (by sea-age class) for commercial and recreational fisheries. Estimates of unreported/illegal catches. Estimates of exploitation rates. Natural mortalities (from earlier assessments).
Discards and bycatch	Discards included in risk-based framework for Faroes fishery. Not relevant for other NEAC assessments.
Indicators	Framework of Indicators (FWI) is used to indicate if a significant change has occurred in the status of stocks in intermediate years where multi-annual management advice applies.
Other information	Advice subject to annual review. Stock annex developed in 2014.
Working group report	Working Group on North Atlantic Salmon WGNAS (ICES, 2014).

ECOREGION **North Atlantic**

STOCK **Atlantic salmon from the Northeast Atlantic**

Reference points

National run–reconstruction models have been used to develop and update national CLs for all countries that do not have river-specific values (i.e. all countries except France, Ireland, UK (England and Wales), and Norway). To provide catch options to NASCO, CLs are required for stock complexes. These have been derived either by summing individual river CLs to national level, or by taking overall national CLs as provided by the national model, and then summing to the level of the four NEAC stock complexes. The CLs have also been used to estimate the spawner escapement reserves (SERs), which are the CLs increased to take account of natural mortality (M = 0.03 per month) between 1 January of the first winter at sea and return time to homewaters for each of the maturing (6–9 months) and non-maturing (16–21 months) 1SW salmon components from the northern NEAC and southern NEAC stock complexes.

Complex	Age group	CL (number)	SER (number)
Northern NEAC	1SW	155 581	196 550
	MSW	129 820	221 222
Southern NEAC	1SW	561 771	708 823
	MSW	275 348	462 347

Outlook for 2014

No outlook is provided because the Framework of Indicators of Northeast Atlantic stocks did not indicate the need for a reassessment this year.

MSY approach

Atlantic salmon has characteristics of short-lived fish stocks; mature abundance is sensitive to annual recruitment because there are only a few age groups in the adult spawning stock. Incoming recruitment is often the main component of the fishable stock. For such fish stocks, the ICES maximum sustainable yield (MSY) approach is aimed at achieving a target escapement (MSY $B_{escapement}$, the amount of biomass left to spawn). No catch should be allowed unless this escapement can be achieved. The escapement level should be set so there is a low risk of future recruitment being impaired, similar to the basis for estimating B_{pa} in the precautionary approach. In short-lived stocks, where most of the annual surplus production is from recruitment (not growth), MSY $B_{escapement}$ and B_{pa} might be expected to be similar. Conservation limits (CLs) for North Atlantic salmon stock complexes have been defined by ICES as the level of stock (number of spawners) that will achieve long-term average maximum sustainable yield (MSY $B_{escapement}$).

To be consistent with the MSY and the precautionary approach, fisheries should only take place on salmon from stocks that can be shown to be above CLs. Furthermore, due to the different status of individual stocks within the stock complex, mixed-stock fisheries present particular threats to stock status.

Additional considerations

The national stock CLs are not appropriate for the management of homewater fisheries. This is because of the relative imprecision of the national CLs and because they will not take account of differences in the status of different river stocks or sub-river populations. Management at finer scales should take account of individual river stock status. Nevertheless, the combined CLs for the main stock groups (national stocks) exploited by the distant water fisheries can be used to provide general management advice to the distant-water fisheries.

Fisheries on mixed stocks pose particular difficulties for management, when they cannot target only stocks that are at full reproductive capacity. The management of a fishery should ideally be based upon the status of all stocks exploited in the fishery. Conservation would be best achieved if fisheries target stocks that have been shown to be at full reproductive capacity. Fisheries in estuaries and, especially, rivers are more likely to meet this requirement.

There has been an overall declining trend in marine survival rates of wild and hatchery-reared smolts in northern and southern NEAC areas, particularly for maturing 1SW salmon (Figure 10.2.5). Five-year average return rates for individual river stocks (not shown in the figure) are also mostly below the average of the previous five years for the majority of monitored hatchery-reared and wild populations in the NEAC area. Results from these analyses are consistent with the information on estimated returns and spawners as derived from the PFA model, and suggest that returns are strongly influenced by factors in the marine environment.

Data and methods

Input data to estimate the historical PFAs are the catch in numbers of 1SW and MSW salmon in each country, unreported catch (minimum and maximum), and exploitation rates (minimum and maximum). Data beginning in 1971 are available for most countries. In addition, catches at the Faroes and catches of NEAC-origin salmon at West Greenland are incorporated. Results are presented in Tables 10.2.2 and 10.2.3.

Uncertainties in assessments and forecasts

The model estimates the PFA from the catch in numbers of 1SW and MSW salmon in each country. Uncertainties are accounted for using minimum and maximum ranges for unreported catches and exploitation rates. A natural mortality value of 0.03 (range 0.02 to 0.04) per month is applied during the second year at sea. Monte Carlo simulation is used to generate confidence intervals of the eggs from spawners and returns to each country.

Comparison with previous assessment and catch options

The NASCO Framework of Indicators of Northeast Atlantic stocks did not indicate the need for a revised analysis of catch options this year and, therefore, no new management advice for 2014 is provided. The assessment was updated to include data up to 2013 and the stock status was consistent with the previous year's assessment.

Assessment and management area

National stocks are combined into southern NEAC and northern NEAC groups. The groups fulfilled an agreed set of criteria for defining stock groups for the provision of management advice (ICES, 2005). Consideration of exploitation rates of national stocks resulted in the advice for the Faroes fishery (both 1SW and MSW) being based upon all NEAC area stocks, and the advice for the West Greenland fishery being based upon the southern NEAC non-maturing 1SW stock only. ICES (2012a) developed a risk framework for providing catch advice for the Faroes fishery at the age and country level for northern and southern NEAC, as well as at the stock complex level. This risk framework has not been formally adopted by NASCO.

ICES (2010, 2011, 2012b) previously emphasized the problem of basing a risk assessment and catch advice for the Faroes fishery on management units comprising large numbers of river stocks. In providing catch advice at the age and stock complex or country levels for northern and southern NEAC areas, consideration needs to be given to the recent performance of the stocks within individual countries. At present, insufficient data are available to assess performance of individual stocks in all countries in the NEAC area. In some instances river-specific CLs are in the process of being developed.

Sources of information

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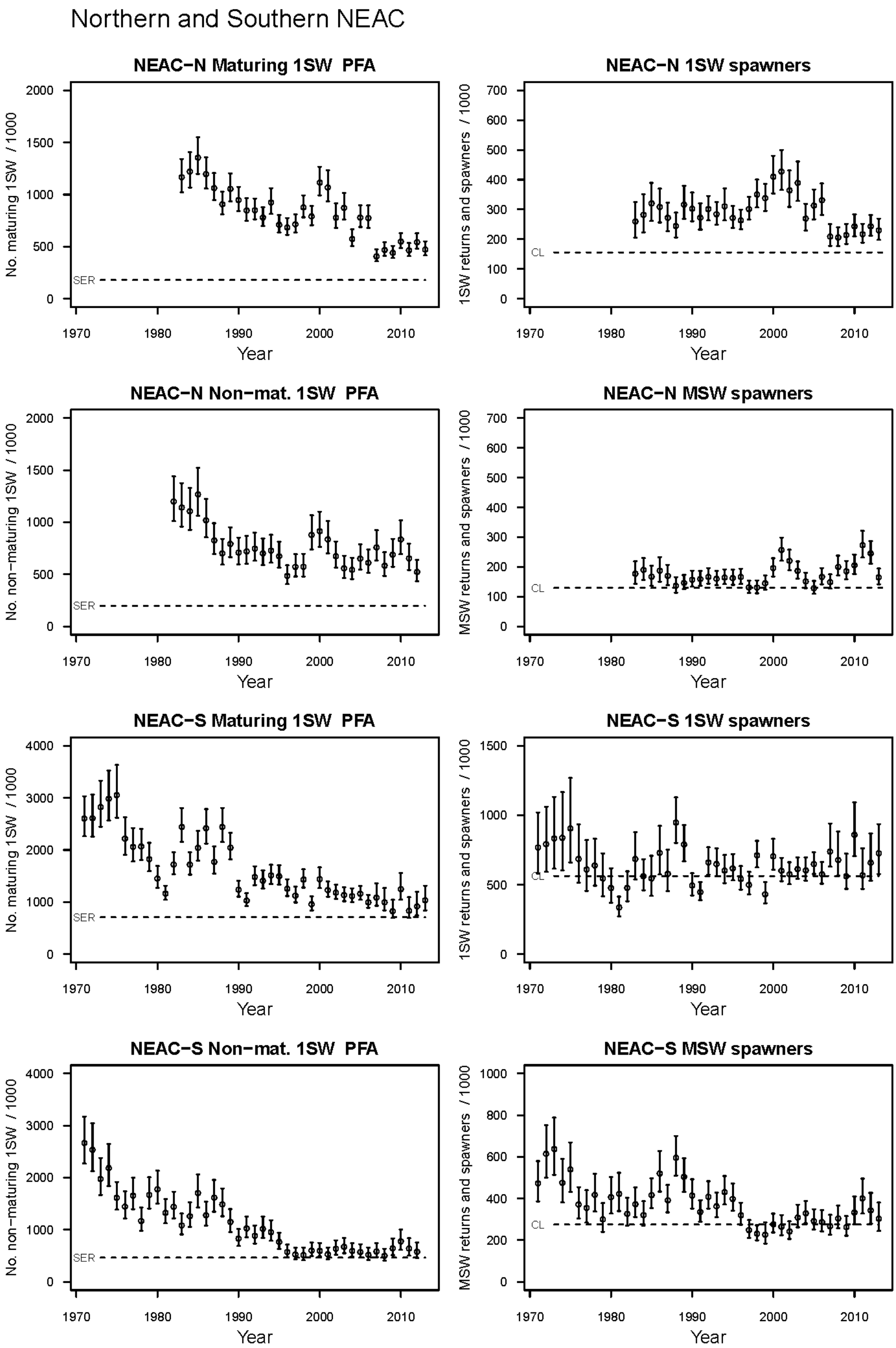


Figure 10.2.1 Estimated PFA (recruits; left panels) and spawner escapement (right panels) with 90% confidence limits, for maturing 1SW (1SW spawners) and non-maturing 1SW (MSW spawners) salmon in the northern (NEAC-N) and southern (NEAC-S) NEAC stock complexes. The dashed horizontal lines in the left panels are the age-specific SER values, and in the right panels the age-specific CL values.

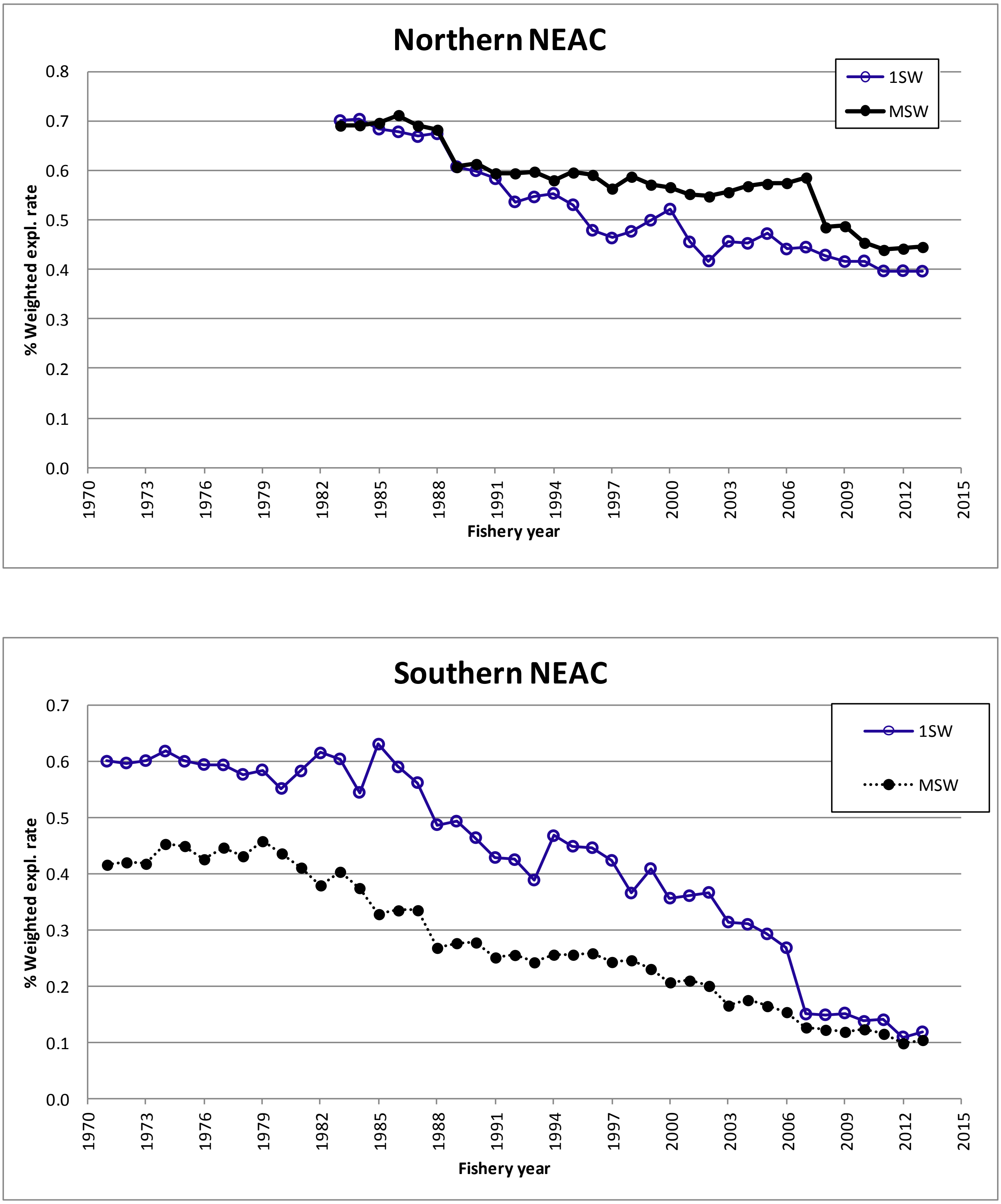


Figure 10.2.2 Mean annual exploitation rate of wild 1SW and MSW salmon by combined commercial and recreational fisheries in the northern NEAC area (upper panel), from 1983 to 2013, and the southern NEAC area (lower panel), from 1971 to 2013.

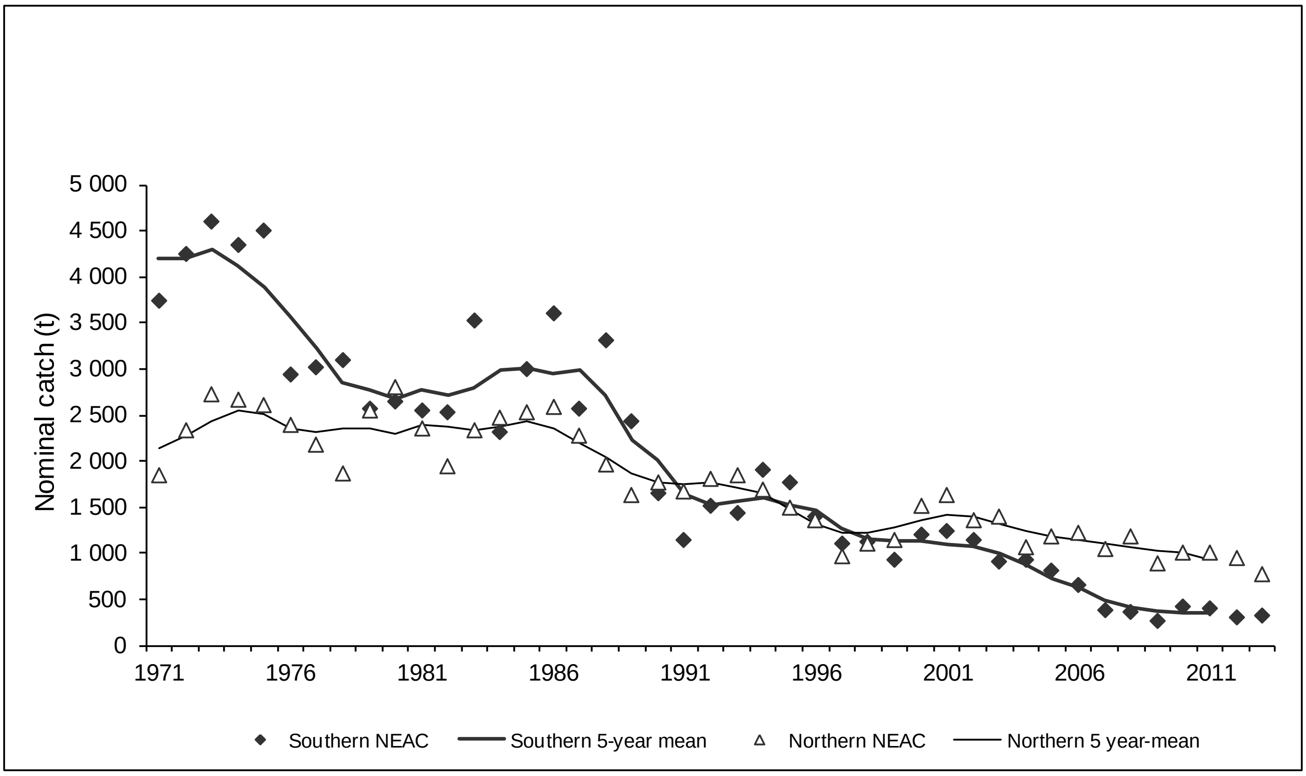
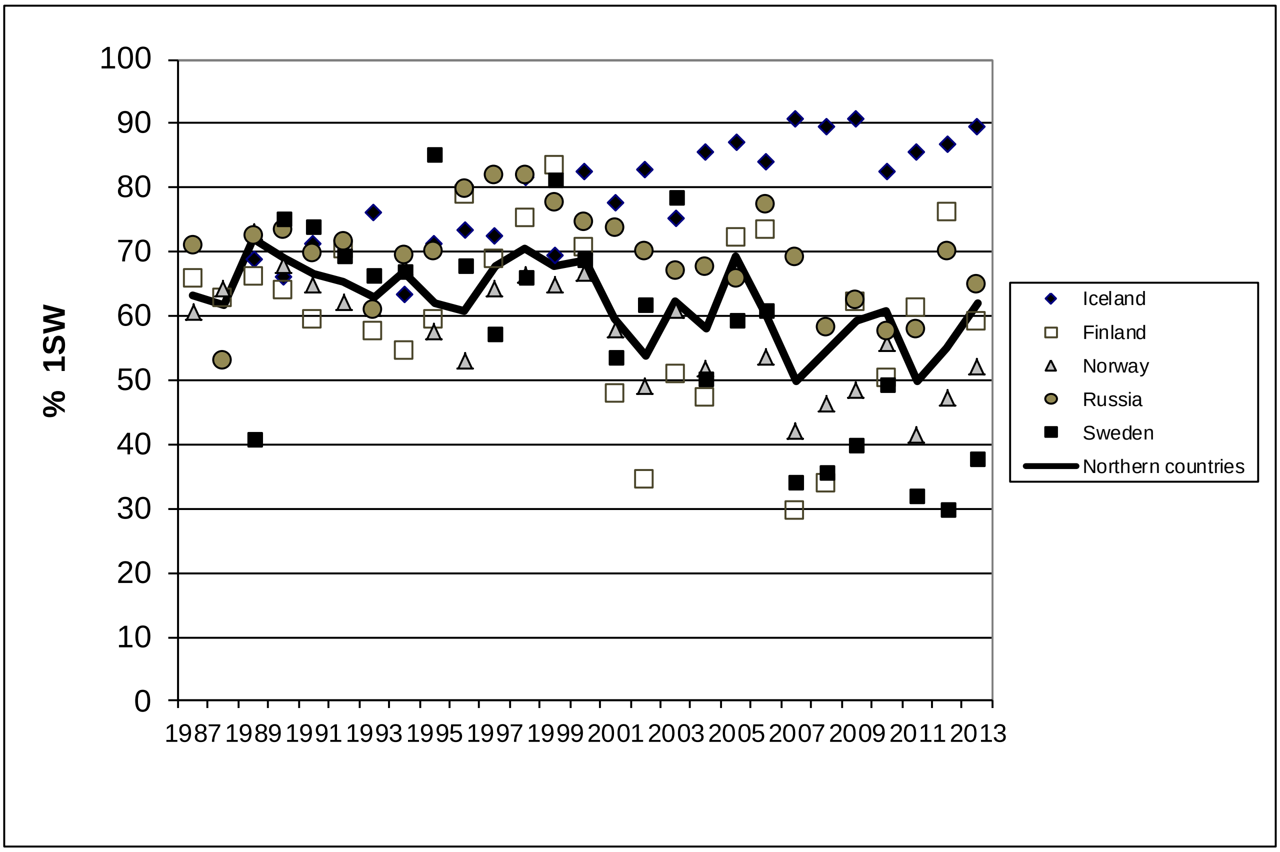


Figure 10.2.3 Nominal catch of salmon and 5-year running means in the southern NEAC and northern NEAC areas, from 1971 to 2013.



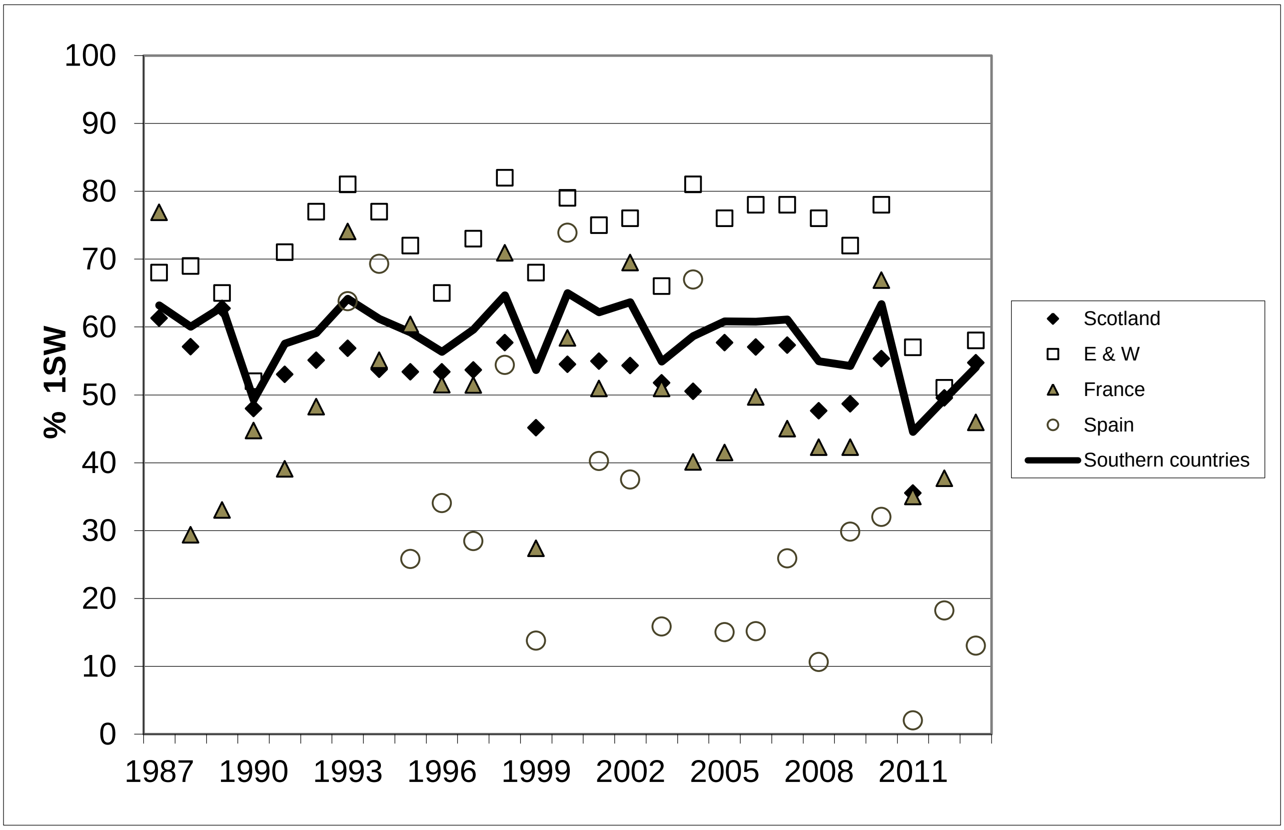


Figure 10.2.4 Percentage of 1SW salmon in the reported catch for northern NEAC countries (upper panel) and southern NEAC countries (lower panel), from 1987 to 2013. Solid line denotes mean value from catches in all countries within the complex.

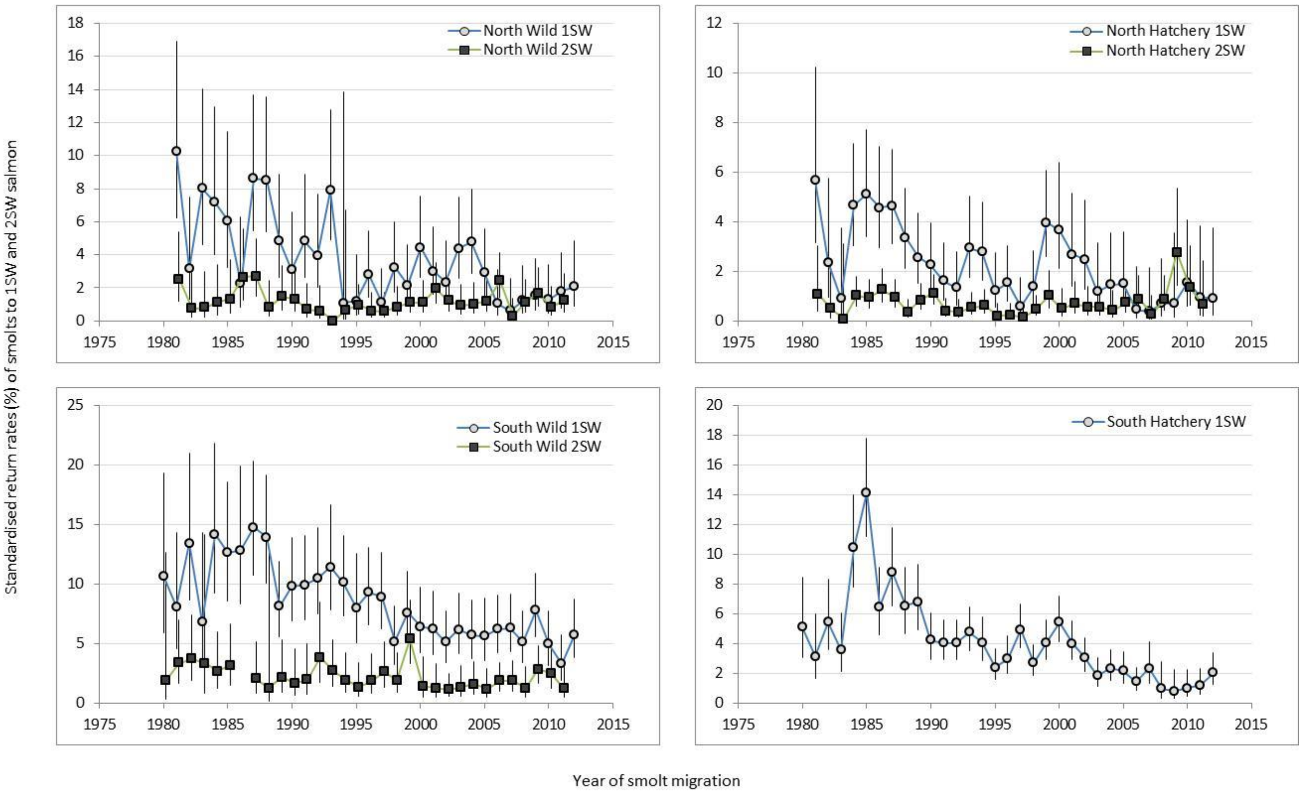


Figure 10.2.5 Standardized mean annual survival indices (%) of wild (left panels) and hatchery origin (right panels) smolts to 1SW and 2SW salmon to northern (top panels) and southern (bottom panels) NEAC areas. The standardized values are annual means derived from a general linear model analysis of rivers in a region. Error values are 95% confidence limits. Note that the scale of the vertical axis differs among panels.

Table 10.2.1 Nominal catch of salmon in the NEAC area (in tonnes, round fresh weight), from 1960 to 2013 (2013 figures are provisional).

Year	Southern countries	Northern countries (1)	Faroes (2)	Other catches in international waters	Total Reported Catch	Unreported catches NEAC Area (3)	Unreported catches International waters (4)
1960	2 641	2 899	-	-	5 540	-	-
1961	2 276	2 477	-	-	4 753	-	-
1962	3 894	2 815	-	-	6 709	-	-
1963	3 842	2 434	-	-	6 276	-	-
1964	4 242	2 908	-	-	7 150	-	-
1965	3 693	2 763	-	-	6 456	-	-
1966	3 549	2 503	-	-	6 052	-	-
1967	4 492	3 034	-	-	7 526	-	-
1968	3 623	2 523	5	403	6 554	-	-
1969	4 383	1 898	7	893	7 181	-	-
1970	4 048	1 834	12	922	6 816	-	-
1971	3 736	1 846	-	471	6 053	-	-
1972	4 257	2 340	9	486	7 092	-	-
1973	4 604	2 727	28	533	7 892	-	-
1974	4 352	2 675	20	373	7 420	-	-
1975	4 500	2 616	28	475	7 619	-	-
1976	2 931	2 383	40	289	5 643	-	-
1977	3 025	2 184	40	192	5 441	-	-
1978	3 102	1 864	37	138	5 141	-	-
1979	2 572	2 549	119	193	5 433	-	-
1980	2 640	2 794	536	277	6 247	-	-
1981	2 557	2 352	1 025	313	6 247	-	-
1982	2 533	1 938	606	437	5 514	-	-
1983	3 532	2 341	678	466	7 017	-	-
1984	2 308	2 461	628	101	5 498	-	-
1985	3 002	2 531	566	-	6 099	-	-
1986	3 595	2 588	530	-	6 713	-	-
1987	2 564	2 266	576	-	5 406	2 554	-
1988	3 315	1 969	243	-	5 527	3 087	-
1989	2 433	1 627	364	-	4 424	2 103	-
1990	1 645	1 775	315	-	3 735	1 779	180-350
1991	1 145	1 677	95	-	2 917	1 555	25-100
1992	1 523	1 806	23	-	3 352	1 825	25-100
1993	1 443	1 853	23	-	3 319	1 471	25-100
1994	1 896	1 684	6	-	3 586	1 157	25-100
1995	1 775	1 503	5	-	3 283	942	-
1996	1 392	1 358	-	-	2 750	947	-
1997	1 112	962	-	-	2 074	732	-
1998	1 120	1 099	6	`	2 225	1 108	-
1999	934	1 139	0	-	2 073	887	-
2000	1 210	1 518	8	-	2 736	1 135	-
2001	1 242	1 634	0	-	2 876	1 089	-
2002	1 135	1 360	0	-	2 495	946	-
2003	908	1 394	0	-	2 302	719	-
2004	919	1 059	0	-	1 978	575	-
2005	809	1 189	0	-	1 998	605	-
2006	650	1 217	0	-	1 867	604	-
2007	373	1 036	0	-	1 409	465	-
2008	355	1 178	0	-	1 533	433	-
2009	265	898	0	-	1 163	317	-
2010	411	1 003	0	-	1 415	357	-
2011	410	1 009	0	-	1 419	382	-
2012	296	955	0	-	1 250	363	-
2013	329	778	0	-	1 107	272	-
Average							
2008-2012	347	1009	0	-	1356	370	-
2003-2012	540	1094	0	-	1633	482	-

1. All Iceland has been included in Northern countries
2. Since 1991, fishing carried out at the Faroes has only been for research purposes.
3. No unreported catch estimate available for Russia since 2008.
4. Estimates refer to season ending in given year.

Table 10.2.2 Estimated pre-fishery abundance (PFA) of maturing 1SW salmon (potential 1SW returns) by NEAC country or region and year.

	Northern Europe								Southern Europe									NEAC Area		
Year	**Finland**	**Iceland**	**Norway**	**Russia**	**Sweden**	**Total**			**France**	**Iceland**	**Ireland**	**UK(EW)**	**UK(NI)**	**UK(Scot)**	**Total**			**Total**		
		N&E				5.0%	50.0%	95.0%		**S&W**					5.0%	50.0%	95.0%	5.0%	50.0%	95.0%
1971	32,074	11,735		NA	22,321				63,331	76,233	1,345,148	105,231	221,904	782,559	2,263,292	**2,610,195**	3,032,226			
1972	123,528	10,720		151,281	17,727				127,354	61,978	1,428,796	101,014	194,318	683,714	2,255,414	**2,616,311**	3,064,007			
1973	57,652	12,866		222,746	21,886				77,568	66,128	1,562,053	119,345	169,888	818,907	2,442,628	**2,831,594**	3,330,607			
1974	79,736	12,856		222,520	31,746				35,986	47,278	1,775,894	149,416	185,863	780,467	2,567,779	**2,989,715**	3,528,552			
1975	95,040	15,686		341,098	34,377				72,191	73,188	1,956,894	153,131	152,812	636,840	2,616,451	**3,059,188**	3,631,857			
1976	86,950	15,741		237,309	19,460				66,277	57,875	1,329,232	102,549	106,177	549,019	1,906,685	**2,224,559**	2,629,032			
1977	48,979	21,735		151,187	8,824				51,178	59,224	1,154,550	116,348	104,554	570,889	1,781,030	**2,066,454**	2,419,114			
1978	46,611	22,145		152,731	10,456				52,274	77,910	1,006,582	132,930	136,153	654,808	1,807,117	**2,073,587**	2,406,392			
1979	42,156	21,268		211,832	10,810				59,401	71,761	924,438	127,316	95,573	539,870	1,593,431	**1,829,694**	2,136,277			
1980	33,637	3,413		151,690	13,897				124,424	32,852	706,378	119,541	121,066	338,416	1,269,988	**1,457,752**	1,691,296			
1981	30,997	16,906		127,411	25,516				99,707	42,766	374,799	125,760	95,715	418,810	1,042,885	**1,168,340**	1,313,254			
1982	18,692	7,951		111,257	22,407				61,258	43,602	770,477	106,729	137,390	598,236	1,535,138	**1,728,485**	1,955,221			
1983	44,194	11,548	896,493	184,824	29,678	1,022,387	**1,169,737**	1,341,314	66,263	54,839	1,357,134	156,160	192,545	610,534	2,153,231	**2,450,179**	2,806,028	3,244,186	**3,625,483**	4,058,432
1984	47,330	4,207	930,150	196,552	41,409	1,067,404	**1,223,646**	1,407,435	106,923	33,717	713,003	136,400	75,576	643,726	1,526,826	**1,723,967**	1,953,993	2,655,244	**2,949,234**	3,282,662
1985	62,112	28,161	944,112	269,277	49,426	1,198,252	**1,358,234**	1,549,133	40,138	54,223	1,178,557	136,982	97,948	530,719	1,792,928	**2,048,372**	2,365,207	3,060,340	**3,413,537**	3,820,069
1986	50,025	35,134	825,671	231,964	51,545	1,057,858	**1,200,472**	1,356,827	62,185	89,701	1,321,020	157,698	110,586	661,153	2,120,986	**2,424,991**	2,784,572	3,246,287	**3,628,740**	4,064,033
1987	59,510	20,700	693,619	246,589	40,974	946,398	**1,065,725**	1,205,507	108,425	55,659	851,369	163,673	60,474	508,562	1,543,135	**1,778,834**	2,071,768	2,549,416	**2,846,731**	3,208,446
1988	35,351	29,879	637,443	170,243	34,406	809,412	**909,951**	1,028,295	37,520	99,563	1,153,687	224,742	141,798	770,115	2,153,188	**2,449,040**	2,805,836	3,014,290	**3,363,834**	3,770,403
1989	76,262	16,169	699,839	252,420	10,203	936,303	**1,058,060**	1,204,688	20,701	55,716	828,573	151,812	136,123	846,297	1,820,552	**2,052,974**	2,326,406	2,811,115	**3,117,562**	3,458,891
1990	76,143	12,025	628,244	208,522	23,341	841,507	**950,255**	1,072,818	34,339	50,970	518,753	108,172	112,665	404,950	1,103,905	**1,243,700**	1,409,112	1,987,214	**2,197,350**	2,429,927
1991	74,711	17,420	546,214	178,127	29,395	750,052	**849,451**	963,677	24,714	56,372	370,913	107,228	62,900	401,883	922,518	**1,034,694**	1,167,185	1,710,420	**1,886,798**	2,084,748
1992	105,298	32,812	459,820	219,173	32,281	761,254	**853,173**	960,271	45,514	64,685	534,215	111,977	127,002	585,575	1,321,912	**1,488,470**	1,684,229	2,120,919	**2,343,346**	2,598,039
1993	70,791	26,933	462,197	188,263	32,227	699,304	**783,880**	879,478	64,661	63,426	436,514	154,821	148,910	525,591	1,260,399	**1,416,509**	1,604,682	1,995,643	**2,201,902**	2,439,315
1994	39,415	8,631	625,625	223,124	24,959	814,332	**926,548**	1,060,820	51,119	52,098	558,215	172,710	102,288	560,470	1,346,558	**1,518,527**	1,717,843	2,213,188	**2,446,242**	2,712,895
1995	39,432	24,793	407,879	200,626	36,569	637,721	**712,734**	801,404	16,998	70,644	624,899	131,469	95,159	551,717	1,333,637	**1,502,092**	1,703,019	2,003,445	**2,217,560**	2,460,703
1996	66,696	13,214	311,183	271,994	21,729	613,502	**687,806**	774,566	21,111	60,818	581,365	97,987	98,274	395,047	1,116,684	**1,264,365**	1,438,168	1,765,443	**1,954,188**	2,171,214
1997	60,336	18,057	358,619	266,999	9,846	637,740	**718,084**	810,622	10,767	44,568	578,929	87,990	116,295	283,783	991,817	**1,130,185**	1,297,438	1,665,879	**1,850,610**	2,066,146
1998	75,965	30,786	467,769	293,457	7,931	781,834	**881,160**	993,318	21,060	61,095	609,056	96,121	253,544	386,518	1,277,568	**1,440,283**	1,628,251	2,101,193	**2,322,617**	2,572,721
1999	101,649	15,628	434,052	225,467	12,553	706,807	**793,078**	892,539	7,039	49,592	567,754	76,014	66,093	191,683	840,915	**963,730**	1,113,582	1,585,993	**1,761,092**	1,961,852
2000	110,045	16,462	716,695	247,130	22,986	993,246	**1,118,635**	1,265,894	18,215	43,870	785,774	116,084	95,819	374,027	1,266,505	**1,446,338**	1,664,964	2,310,388	**2,566,948**	2,865,555
2001	79,866	14,942	618,988	333,072	14,301	933,373	**1,071,085**	1,233,636	15,816	39,212	626,800	101,205	75,849	366,948	1,102,633	**1,236,769**	1,393,005	2,084,172	**2,310,421**	2,563,442
2002	54,190	25,923	378,142	304,312	13,707	679,451	**781,752**	915,723	35,639	49,050	548,027	95,350	149,939	295,526	1,061,668	**1,187,449**	1,334,651	1,782,749	**1,973,877**	2,195,497
2003	53,800	13,744	523,212	269,995	7,485	761,325	**875,556**	1,014,634	23,356	58,553	536,323	73,865	97,879	335,296	1,016,119	**1,139,555**	1,282,982	1,819,161	**2,017,792**	2,244,049
2004	22,698	37,184	317,531	189,241	6,265	505,430	**577,515**	666,293	28,317	58,827	395,624	133,598	87,546	398,064	996,787	**1,120,604**	1,264,599	1,533,897	**1,700,274**	1,887,282
2005	49,959	32,943	470,778	216,437	6,131	688,705	**782,552**	898,129	18,505	86,637	393,164	109,373	111,076	432,607	1,042,957	**1,166,547**	1,308,460	1,769,192	**1,951,798**	2,164,306
2006	87,511	34,784	381,524	260,839	6,828	680,484	**777,662**	895,792	25,952	61,375	301,642	106,792	71,092	419,113	890,925	**1,001,657**	1,137,679	1,608,262	**1,785,278**	1,985,209
2007	25,539	25,757	213,532	140,828	2,118	359,057	**410,177**	473,241	20,160	70,121	343,073	101,703	115,356	411,495	928,986	**1,091,785**	1,358,502	1,317,924	**1,507,604**	1,782,981
2008	27,537	23,556	267,363	146,077	3,303	412,146	**471,500**	541,299	19,923	84,843	340,529	100,218	68,920	354,379	841,458	**1,001,687**	1,267,654	1,290,553	**1,480,203**	1,758,283
2009	48,645	37,971	213,824	137,107	3,498	391,162	**444,185**	506,281	7,088	95,833	282,951	63,073	52,543	302,986	695,557	**829,844**	1,042,210	1,118,674	**1,278,051**	1,504,308
2010	39,362	30,422	316,608	156,670	5,976	486,662	**552,705**	628,763	24,387	98,503	357,527	124,767	48,109	552,776	1,042,633	**1,255,400**	1,561,340	1,569,278	**1,811,077**	2,133,934
2011	44,508	24,986	223,470	167,141	5,106	410,279	**467,781**	535,390	17,020	69,493	314,270	72,871	41,801	295,993	695,753	**838,483**	1,092,132	1,140,705	**1,312,810**	1,577,845
2012	76,941	13,089	248,568	195,257	7,216	479,637	**546,612**	626,843	14,631	39,402	320,185	44,871	63,232	394,460	742,840	**924,002**	1,197,017	1,263,841	**1,475,242**	1,766,643
2013	44,493	36,170	233,981	151,858	4,144	416,672	**475,480**	549,277	20,673	91,775	298,881	56,245	46,858	471,255	836,320	**1,040,599**	1,313,309	1,291,359	**1,519,800**	1,810,767
10yr Av.	46,719	29,686	288,718	176,145	5,059	483,023	**550,617**	632,131	19,666	75,681	334,785	91,351	70,653	403,313	871,422	**1,027,061**	1,254,290	1,390,369	**1,582,214**	1,837,156

Year	Northern Europe								Southern Europe									NEAC Area		
	Finland	Iceland	Norway	Russia	Sweden	Total			France	Iceland	Ireland	UK(EW)	UK(NI)	UK(Scot)	Total			Total		
		N&E				5.0%	50.0%	95.0%		S&W					5.0%	50.0%	95.0%	5.0%	50.0%	95.0%
1971	52,462	28,471		268,996	5,689				56,319	66,084	394,140	368,775	34,351	1,743,860	2,273,240	**2,672,992**	3,170,521			
1972	79,456	26,908		431,948	8,436				36,821	59,602	387,869	278,078	30,707	1,737,269	2,128,562	**2,541,517**	3,049,789			
1973	125,860	24,989		399,600	5,754				21,488	51,386	409,247	207,150	32,458	1,251,038	1,664,744	**1,982,272**	2,375,330			
1974	160,608	27,852		433,313	4,584				31,562	54,599	448,220	259,231	27,572	1,356,569	1,836,071	**2,190,324**	2,645,600			
1975	125,094	22,679		369,349	5,308				28,547	47,097	342,119	178,828	19,007	1,000,092	1,386,435	**1,621,047**	1,914,244			
1976	86,392	30,586		254,230	2,945				18,964	45,605	274,946	171,818	18,284	912,503	1,217,414	**1,451,483**	1,736,908			
1977	45,458	38,924		219,382	3,086				21,372	58,746	253,761	163,404	23,261	1,134,320	1,393,914	**1,659,812**	1,999,738			
1978	47,158	26,460		200,637	5,034				18,579	37,996	210,155	82,286	17,196	804,618	977,500	**1,175,425**	1,430,168			
1979	55,453	38,144		351,297	10,715				36,725	54,282	249,357	225,420	23,772	1,075,048	1,407,923	**1,676,175**	2,008,349			
1980	71,209	17,284		246,836	9,085				28,252	38,161	202,556	301,473	21,858	1,182,416	1,499,643	**1,783,588**	2,132,425			
1981	85,524	18,747		221,125	13,240				19,601	27,581	133,568	140,961	28,337	978,862	1,124,675	**1,333,147**	1,588,600			
1982	88,288	14,357	812,705	274,489	9,580	1,010,339	**1,203,436**	1,439,918	19,261	43,514	215,636	147,167	36,201	980,605	1,219,169	**1,448,005**	1,730,907	2,260,693	**2,652,248**	3,129,621
1983	70,572	16,126	793,213	253,815	8,984	958,278	**1,145,101**	1,376,093	24,223	36,382	147,264	107,342	15,312	752,742	910,535	**1,090,063**	1,309,640	1,893,875	**2,237,738**	2,644,758
1984	68,807	11,364	740,653	279,853	5,749	927,010	**1,109,217**	1,329,815	18,683	26,864	157,211	146,983	19,220	890,029	1,051,940	**1,267,116**	1,528,900	2,011,988	**2,376,639**	2,820,457
1985	61,210	27,292	890,168	284,308	5,834	1,063,155	**1,270,907**	1,522,972	22,960	23,017	198,632	217,503	21,873	1,219,740	1,425,745	**1,711,353**	2,062,595	2,530,224	**2,987,338**	3,538,070
1986	75,327	27,958	687,158	219,256	9,078	855,673	**1,022,289**	1,223,320	13,863	20,543	227,444	172,960	12,726	831,224	1,078,623	**1,284,407**	1,540,025	1,962,676	**2,307,951**	2,727,311
1987	50,512	17,681	550,709	199,439	7,437	693,243	**829,106**	990,653	28,442	22,283	168,811	212,320	27,874	1,153,677	1,346,457	**1,623,852**	1,956,772	2,069,902	**2,453,552**	2,910,615
1988	51,003	15,543	415,761	199,823	20,520	593,986	**705,468**	840,713	17,452	20,219	167,842	186,971	22,974	1,072,638	1,259,531	**1,493,674**	1,791,961	1,870,243	**2,199,948**	2,608,613
1989	53,532	15,862	469,797	243,145	11,240	666,016	**795,457**	952,467	13,484	19,752	76,756	196,750	20,525	821,857	957,879	**1,155,922**	1,396,486	1,647,804	**1,952,895**	2,322,202
1990	67,498	10,838	386,836	231,015	13,567	595,575	**712,309**	852,056	11,363	19,349	100,484	87,272	10,691	603,537	689,561	**836,390**	1,015,820	1,302,775	**1,550,415**	1,844,582
1991	64,061	15,442	410,713	214,358	17,921	603,852	**724,529**	869,922	15,125	21,518	84,846	74,490	22,682	809,734	856,259	**1,031,608**	1,257,221	1,484,085	**1,756,844**	2,099,135
1992	66,649	17,362	392,217	252,688	20,051	630,587	**750,547**	900,335	7,507	10,660	79,098	76,469	52,788	656,358	732,190	**889,031**	1,080,139	1,382,457	**1,640,663**	1,954,080
1993	62,970	14,730	383,270	226,162	15,389	588,708	**704,736**	845,700	13,017	17,134	114,357	98,052	18,884	758,284	842,296	**1,024,119**	1,258,065	1,450,371	**1,730,738**	2,075,127
1994	42,217	10,442	412,548	257,421	8,011	612,941	**732,198**	879,733	6,405	19,317	110,804	98,411	16,208	703,344	787,352	**960,389**	1,181,157	1,420,704	**1,694,290**	2,031,675
1995	43,048	13,480	410,925	194,442	12,561	566,713	**677,298**	812,792	11,363	12,467	76,253	101,637	17,656	547,898	634,815	**771,889**	945,857	1,222,187	**1,452,077**	1,734,737
1996	49,927	7,402	265,517	154,751	8,708	407,145	**488,220**	588,545	5,928	13,797	96,062	63,587	21,379	370,927	472,688	**580,164**	716,861	894,927	**1,068,905**	1,283,575
1997	47,929	10,807	318,729	191,727	4,854	480,069	**575,405**	692,103	4,925	8,536	55,617	41,355	29,341	388,756	435,789	**532,675**	654,836	931,748	**1,110,559**	1,327,110
1998	50,860	12,351	339,793	168,424	3,441	478,514	**576,689**	695,996	10,320	16,645	85,505	80,205	13,368	297,719	414,110	**519,036**	656,279	912,547	**1,098,022**	1,324,045
1999	96,989	7,267	470,781	294,620	12,227	737,533	**882,026**	1,065,749	7,187	4,536	107,092	83,380	17,852	380,459	495,666	**608,282**	754,079	1,256,789	**1,491,425**	1,791,965
2000	129,108	8,314	555,704	207,203	14,539	763,589	**916,778**	1,101,738	8,712	7,941	97,771	92,332	13,101	372,602	487,074	**601,110**	744,400	1,275,585	**1,518,523**	1,819,458
2001	113,394	7,879	481,499	225,356	9,945	699,734	**839,495**	1,011,031	7,847	8,621	110,787	82,094	15,502	299,890	434,185	**535,015**	659,828	1,154,808	**1,376,807**	1,642,221
2002	81,553	8,258	426,059	158,132	2,390	564,352	**678,181**	815,297	11,292	13,751	116,503	104,631	10,132	372,993	517,614	**641,592**	795,898	1,103,258	**1,321,140**	1,582,890
2003	36,944	8,143	385,369	121,470	7,316	465,470	**560,371**	678,446	20,834	11,137	63,908	88,000	9,065	476,803	549,373	**679,480**	845,541	1,036,427	**1,242,164**	1,497,028
2004	30,716	10,081	354,923	145,203	4,907	455,002	**547,646**	658,891	12,788	9,813	82,700	96,780	11,480	376,109	486,712	**599,585**	743,964	959,220	**1,147,191**	1,378,821
2005	48,546	9,677	449,819	139,379	5,129	545,357	**653,899**	787,595	12,932	8,131	60,310	87,773	7,354	389,837	463,180	**579,288**	722,664	1,030,918	**1,234,578**	1,482,118
2006	69,928	9,294	382,642	145,516	4,815	513,110	**614,359**	737,372	12,249	5,004	27,389	84,018	10,114	375,747	418,284	**523,832**	658,256	951,789	**1,137,844**	1,369,187
2007	70,900	11,979	441,733	229,520	6,794	632,212	**762,463**	923,669	13,518	5,739	40,608	92,517	6,126	421,929	471,352	**590,560**	742,293	1,129,652	**1,356,388**	1,631,164
2008	30,309	9,648	345,457	194,053	5,934	485,379	**587,219**	711,838	7,084	8,873	45,766	71,471	7,995	356,911	403,778	**505,667**	636,350	910,456	**1,094,136**	1,319,153
2009	48,708	13,718	380,737	239,970	6,891	572,488	**692,428**	840,421	5,982	18,366	29,457	103,948	7,365	471,676	512,819	**648,560**	832,118	1,115,928	**1,342,939**	1,634,115
2010	37,585	15,238	531,287	239,642	12,982	692,465	**838,509**	1,018,899	15,544	9,323	34,234	154,179	19,161	534,564	612,884	**782,689**	1,002,388	1,342,607	**1,625,956**	1,971,524
2011	45,218	8,606	464,146	117,101	18,514	541,114	**656,797**	794,919	12,070	5,313	35,928	126,547	28,432	418,192	504,107	**646,865**	838,921	1,076,305	**1,306,347**	1,592,173
2012	43,521	10,328	328,574	134,338	7,855	434,998	**526,728**	638,533	12,068	11,314	36,422	113,370	13,346	382,009	454,236	**583,605**	759,457	913,835	**1,113,217**	1,364,639
10yr Av.	46,238	10,671	406,469	170,619	8,114	533,760	**644,042**	779,058	12,507	9,301	45,672	101,860	12,044	420,378	487,672	**614,013**	778,195	1,046,714	**1,260,076**	1,523,992

Table 10.2.3 Estimated pre-fishery abundance (PFA) of non-maturing 1SW salmon (potential MSW returns) by NEAC country or region and year.

ECOREGION **North Atlantic**

STOCK **Atlantic salmon from North America**

Advice for 2014

Because the NASCO Framework of Indicators of North American stocks for 2013 (run in January 2014) did not indicate the need for a revised analysis of catch options, no new management advice for 2014 is provided. The most recent multi-year advice for the North American Commission was provided by ICES (2012). In that assessment, no mixed-stock fishery catch options for 2012 to 2015 on 1SW non-maturing and 2SW salmon in North America were consistent with the management objectives defined for this stock complex. Management advice in the form of catch options is only provided by ICES for the non-maturing 1SW and maturing 2SW components, as the maturing 1SW component is not fished outside of homewaters.

While stocks remain in a depleted state particular care should be taken to ensure that fisheries in homewaters are managed to protect stocks that are below their CLs.

Stock status

The regional groupings of stock units used for management in North America is indicated in Figure 10.3.1. Estimates of pre-fishery abundance (PFA, defined as the number of maturing and non-maturing 1SW salmon on 1 August of the second summer at sea) suggest continued low abundance of North American adult salmon (Figure 10.3.2). The estimated PFA of 1SW maturing salmon in 2013 ranks 30th in the 43-year time-series, and the estimated PFA of 1SW non-maturing salmon in 2012 (the latest available PFA year) ranks 26th in the 42-year time-series. Egg depositions by all sea ages combined in 2013 exceeded or equalled the river-specific CLs in 44 of the 73 assessed rivers (60%) and were less than 50% of CLs in 16 rivers (22%) (Figure 10.3.3). In 2013, 2SW spawner estimates for five of the six geographic areas were below their CLs and are suffering reduced reproductive capacity (Figure 10.3.4). In 2013, the median estimate of 2SW spawners in Labrador exceeded the CL for the first time in the assessment time-series beginning in 1971. Despite this improvement, the stock is assessed to be at risk of suffering reduced reproductive capacity (Figure 10.3.4). Particularly large deficits are noted in Scotia–Fundy and USA. Exploitation rates on the North American complexes of small salmon (mostly 1SW maturing) and large salmon (all other sea age groups) have declined and in the last few years have been at the lowest in the time-series, averaging 10% for large salmon and 15% for small salmon over the past ten years (Figure 10.3.6).

Despite major changes in fisheries management around 20 to 30 years ago, and increasingly more restrictive fisheries measures since then, returns have remained near historical lows and many populations are currently threatened with extirpation. The continued low abundance of salmon stocks across North America, despite significant fishery reductions, further strengthens the conclusions that factors other than fisheries are constraining production.

Management plans

The North Atlantic Salmon Conservation Organization (NASCO) has adopted an Action Plan for Application of the Precautionary Approach which stipulates that management measures should be aimed at maintaining all stocks above their conservation limits by the use of management targets. NASCO has adopted the region-specific CLs as limit reference points (S_{lim}); having populations fall below these limits should be avoided with high probability. Within the agreed management plan, a risk level (probability) of 75% for simultaneous attainment of management objectives in all regional groupings (Figure 10.3.1) has been agreed for the provision of catch advice on 2SW salmon exploited at West Greenland (as non-maturing 1SW fish) and in North America (as non-maturing 1SW and 2SW salmon). For the North American Commission, the current management objectives are attaining the 2SW CLs in the four northern areas (Labrador, Newfoundland, Québec, and Gulf), and achieving a 25% increase in regional returns relative to a baseline period (average returns in 1992–1996) for the two southern regions (Scotia–Fundy and USA). A revised management objective has been proposed this year in respect of the USA, which is more in line with recovery criteria under the US Endangered Species Act. This would increase the management objective for the USA from 2548 to 4549 fish. The implications of this change for the provision of catch advice at West Greenland are evaluated in Section 10.1.12.

Biology

Atlantic salmon (*Salmo salar*) is an anadromous species found in rivers of countries bordering the North Atlantic. In the Northwest Atlantic they range from the Connecticut River (USA, 41.6°N) northward to 58.8°N (Québec, Canada). Juveniles emigrate to the ocean at ages of one to eight years (dependent on latitude) and generally return after one or two years at sea. Long-distance migrations to ocean feeding grounds take place, with adult salmon from both North American and Northeast Atlantic stocks migrating to West Greenland to feed in their second summer and autumn at sea.

Environmental influence on the stock

Environmental conditions in both freshwater and marine environments have a marked effect on the status of salmon stocks. Across the North Atlantic, a range of problems in the freshwater environment play a significant role in explaining the poor status of stocks. In many cases, factors such as river damming and habitat deterioration have had a devastating effect on freshwater environmental conditions. In the marine environment, return rates of adult salmon have declined through the 1980s and are now at the lowest levels in the time-series for some stocks, even after closure of marine fisheries. Climatic factors modifying ecosystem conditions and predator fields of salmon at sea are considered to be important contributory factors to lower productivity, which is expressed almost entirely in terms of lower marine survival.

The fisheries

Three groups exploit salmon in Canada: Aboriginal peoples, residents fishing for food in Labrador, and recreational fishers. The provisional reported harvest of salmon by all users in Canada in 2013 was 136 t (Table 10.3.1). The dramatic decline in harvested tonnage since 1988 (Figure 10.3.5) is in large part the result of the reductions in effort in commercial fisheries, with closure of the insular Newfoundland commercial fishery in 1992, closure of the Labrador commercial fishery in 1998, and closure of the Québec commercial fishery in 2000. All commercial fisheries for Atlantic salmon remained closed in Canada in 2013 and the catch therefore was zero. The total reported harvests were 58.6 t for the Aboriginal peoples' food fisheries, 2.1 t for residents fishing for food in Labrador, and 75.4 t (about 38 600 small and large salmon) in the recreational fisheries. In 2013, approximately 59 200 salmon (about 33 500 small and 25 700 large) were caught and released by recreational fishers, representing about 61% of the total number caught (including retained fish). France (Islands of Saint-Pierre and Miquelon) reported a total harvest of 5.3 t in the professional and recreational fisheries in 2013 (Table 10.3.1); this was the highest in the time series starting in 1983. There are no commercial or recreational fisheries for Atlantic salmon in USA (Table 10.3.1).

	Canada				St Pierre & Miquelon	USA
	Commercial	Aboriginal	Labrador resident	Recreational		
2013 catch (t)	0	58.6	2.1	75.4	5.3	0
% of NAC total	-	41	1.5	53	4	-

Effects of the fisheries on the ecosystem

The current salmon fisheries probably have no, or only minor, influence on the marine ecosystem. However, the exploitation rate on salmon may affect the riverine ecosystem through changes in species composition. There is limited knowledge on the magnitude of any such effects.

Quality considerations

Uncertainties in input variables to the stock status and stock forecast models are incorporated in the assessment. Because of the absence of catch data from some regions in Canada, the values were estimated based on historical exploitation rates. Estimates of abundance of adult salmon in some areas, in particular Labrador, are based on a small number of counting facilities raised to a large production area.

Scientific basis

Assessment type	Run–reconstruction models and Bayesian forecasts, taking into account uncertainties in the data.
Input data	Nominal catches (by sea-age class) for commercial and recreational fisheries. Estimates of unreported/illegal catches. Estimates of exploitation rates. Natural mortalities (from earlier assessments).
Discards and bycatch	There are no salmon discarded in the fisheries.
Indicators	Framework of Indicators used to indicate if a significant change has occurred in the status of stocks in intermediate years where multi-annual management advice applies.
Other information	Advice subject to annual review. A stock annex was developed in 2014.
Working group report	WGNAS (ICES, 2014).

ECOREGION **North Atlantic**

STOCK **Atlantic salmon from North America**

Reference points

Conservation limits for 2SW salmon to North America currently total 152 548 fish. At present, the management objectives for Scotia–Fundy and USA are based on achieving an increase of 25% in returns of 2SW salmon from the mean return in the years 1992 to 1996.

COUNTRY AND COMISSION AREA	STOCK AREA	2SW CONSERVATION LIMIT (NUMBER OF FISH)	MANAGEMENT OBJECTIVE (NUMBER OF FISH)
	Labrador	34 746	34 746
	Newfoundland	4 022	4 022
	Gulf of St Lawrence	30 430	30 430
	Quebec	29 446	29 446
	Scotia–Fundy	24 705	10 976
Canada Total		123 349	
USA		29 199	2 548
North American Commission		152 548	

A revised management objective has been proposed this year in respect of the USA which is more in line with recovery criteria under the US Endangered Species Act. This would increase the management objective for the USA from 2548 to 4549 fish. The implications of this change for the provision of catch advice at West Greenland are evaluated in Section 10.1.12. If accepted by NASCO, the revised management objective would be stated as: “achieve 2SW adult returns of 4549 or greater for the USA region”.

Outlook for 2014

No outlook is provided because the Framework of Indicators of North American stocks did not indicate the need for a reassessment this year.

MSY approach

Atlantic salmon has characteristics of short-lived fish stocks; mature abundance is sensitive to annual recruitment because there are only few age groups in the adult spawning stock. Incoming recruitment is often the main component of the fishable stock. For such fish stocks, the ICES maximum sustainable yield (MSY) approach is aimed at achieving a target escapement (MSY $B_{escapement}$, the amount of biomass left to spawn). No catch should be allowed unless this escapement can be achieved. The escapement level should be set so there is a low risk of future recruitment being impaired, similar to the basis for estimating B_{pa} in the precautionary approach. In short-lived stocks, where most of the annual surplus production is from recruitment (not growth), MSY $B_{escapement}$ and B_{pa} might be expected to be similar. Conservation limits (CLs) for North Atlantic salmon stock complexes have been defined by ICES as the level of stock (number of spawners) that will achieve long-term average maximum sustainable yield (MSY $B_{escapement}$).

ICES considers that to be consistent with the MSY and the precautionary approach, fisheries should only take place on salmon from rivers where stocks have been shown to be at full reproductive capacity. Furthermore, due to the different status of individual stocks within the stock complex, mixed-stock fisheries present particular threats to stock status.

Additional considerations

The management of a fishery should ideally be based upon the status of all stocks exploited in the fishery. Conservation would be best achieved if fisheries target stocks that have been shown to be at full reproductive capacity. Fisheries in estuaries and especially rivers are more likely to meet this requirement.

Most catches (over 90%) in North America now take place in rivers or in estuaries. Fisheries are principally managed on a river-by-river basis and, in areas where retention of large salmon is allowed, it is closely controlled. The commercial fisheries are now closed and the remaining coastal food fisheries in Labrador are mainly located in bays, generally inside the headlands. The coastal fishery in St. Pierre & Miquelon (SPM) is a mixed-stock fishery which catches salmon from various stocks in North America; there are no salmon producing rivers in SPM.

In recent years, progress has been made in determining the stock origin of the salmon caught in the estuarine and coastal fisheries at Labrador and in SPM using genetic analysis techniques and based on a North American genetic database of standardized markers. This is needed to provide the information necessary to evaluate the effect that these mixed-stock fisheries have on the contributing populations. Data on the biological characteristics and origin of the fish are important parameters in the run–reconstruction model for North America and in the development of catch advice. Genetic analysis of samples from the Labrador subsistence fisheries from 2006 to 2011 showed that 85–98% were of Labrador origin, with small percentages from most other regional groups in North America, including the USA. More recent samples are currently being processed. Sampling at SPM also provided new information on the origin of fish taken in that fishery, with stocks from various regions in Canada being exploited. Further information is provided in Section 10.1.6.8. ICES has recommended that these sampling programmes should be continued and expanded.

The returns of 2SW fish in 2013 increased from 2012 in five of the six geographic areas of North America, while 2SW returns in the USA in 2013 were 40% lower than 2012 and close to the lowest in the time-series (Figure 10.3.4). In general, the increases in 2SW returns in 2013 in the regions of Canada were modest, with values remaining close to the recent five-year mean in most areas. However, there was a particularly large increase in 2SW returns to Labrador, which were more than double the average of the previous five years and the highest in the time-series back to 1971. The uncertainty in the estimates of returns and spawners in Labrador is high. Returns of 1SW salmon in 2013 relative to 2012 increased in four areas, and decreased in two (Newfoundland and Québec). However, returns of 1SW salmon in many areas (Québec, Gulf, Scotia–Fundy, and USA) remain among the lowest in the time-series.

The rank of the estimated 1SW and 2SW returns in the 1971 to 2013 and 2004 to 2013 time-series, and the proportions of the 2SW CL achieved in 2013, for six regions in North America are shown below:

	Rank of 2013 returns in 1971 to 2013, (43 = Lowest)		Rank of 2013 returns in 2004 to 2013 (10 = Lowest)		Median estimate of 2SW spawners as percentage of conservation limit
Region	**1SW**	**2SW**	**1SW**	**2SW**	(%)
Labrador	6	1	6	1	127
Newfoundland	14	28	7	8	85
Québec	38	31	8	3	76
Gulf	42	31	9	5	80
Scotia–Fundy	42	33	9	3	12
USA	37	42	9	10	2

Data and methods

The returns for individual river systems and management areas for both sea-age groups were derived from a variety of methods. These methods included counts of salmon at monitoring facilities, population estimates from mark–recapture studies, and applying angling and commercial catch statistics, angling exploitation rates, and measurements of freshwater habitat. The 2SW component of the large returns was determined using the sea-age composition of one or more indicator stocks. Returns of small (1SW), large, and 2SW salmon (a subset of large) to each region were originally estimated by the methods and variables developed by Rago *et al.* (1993) and reported by ICES (1993).

Returns are the number of salmon that returned to the geographic region, including fish caught by homewater commercial fisheries, except in the case of the Newfoundland and Labrador regions, where returns do not include landings in commercial and food fisheries. This avoided double counting of fish because commercial catches in Newfoundland and Labrador and food fisheries in Labrador were added to the sum of regional returns to create the PFA of North American salmon. Total returns of salmon to USA rivers are the sum of trap catches and redd-based estimates.

Uncertainties in assessments and forecasts

To date, 1082 Atlantic salmon rivers have been recorded in eastern Canada and 21 rivers in eastern USA where salmon are or have been present within the last half century. Conservation requirements in terms of eggs have been defined for 45% (485) of the 1082 rivers in Canada. For over 59% of the rivers with defined conservation requirements, these are less than 1 million eggs, which translates roughly into 200 to 300 spawners, depending upon life history type. Collectively, 91% of the rivers have conservation requirements of less than five million eggs. Assessments were reported for 73 North American rivers in 2013, 66 in Canada and 7 in USA.

Recreational catch statistics for Atlantic salmon are not collected regularly in Canada and there is no mechanism in place that requires anglers to report their catches, except in Québec. The reliability of recreational catch statistics could be improved in all areas of Canada.

The unreported catch for Canada is estimated at 23.9 t in 2013, mostly from illegal retention in fisheries directed at salmon. No unreported catch estimate has been provided for St Pierre and Miquelon.

Comparison with previous assessment and catch options

The NASCO Framework of Indicators of North American stocks did not indicate the need for a revised analysis of catch options this year and, therefore, no new management advice for 2014 is provided. The assessment was updated to include data up to 2013 and the stock status was consistent with the previous year's assessment.

Assessment and management area

The advice for the North America Commission is based upon the objectives agreed by NASCO for the six geographic areas of North America (Figure 10.3.1).

Sources of information

ICES. 1993. Report of the North Atlantic Salmon Working Group. Copenhagen, 5–12 March 1993. ICES CM 1993/Assess:10.

ICES. 2012. Atlantic salmon from North America. *In* Report of the ICES Advisory Committee, 2012. ICES Advice 2012, Book 10: 58–75.

ICES. 2013a. Atlantic salmon from North America. *In* Report of the ICES Advisory Committee, 2013. ICES Advice 2013, Book 10, Section 10.3.

ICES. 2013b. Report of the Working Group on North Atlantic Salmon (WGNAS). ICES Headquarters, Copenhagen, 3–12 April 2013. ICES CM 2013/ACOM:09. 380 pp.

ICES. 2014. Report of the Working Group on North Atlantic Salmon (WGNAS), 19–28 March 2014, Copenhagen, Denmark. ICES CM 2014/ACOM:09. 107 pp.

NASCO. 1998. North Atlantic Salmon Conservation Organization. Agreement on the adoption of a precautionary approach. Report of the 15th annual meeting of the Council. CNL(98)46. 4 pp.

NASCO. 1999. North Atlantic Salmon Conservation Organization. Action plan for the application of the precautionary approach. CNL(99)48. 14 pp.

Rago, P. J., Reddin, D. G., Porter, T. R., Meerburg, D. J., Friedland, K. D., and Potter, E. C. E. 1993. A continental run–reconstruction model for the non-maturing component of North American Atlantic salmon: analysis of fisheries in Greenland and Newfoundland Labrador, 1974–1991. ICES CM 1993/M:25.

Figure 10.3.1 Regional groupings of Atlantic salmon in the North American Commission.

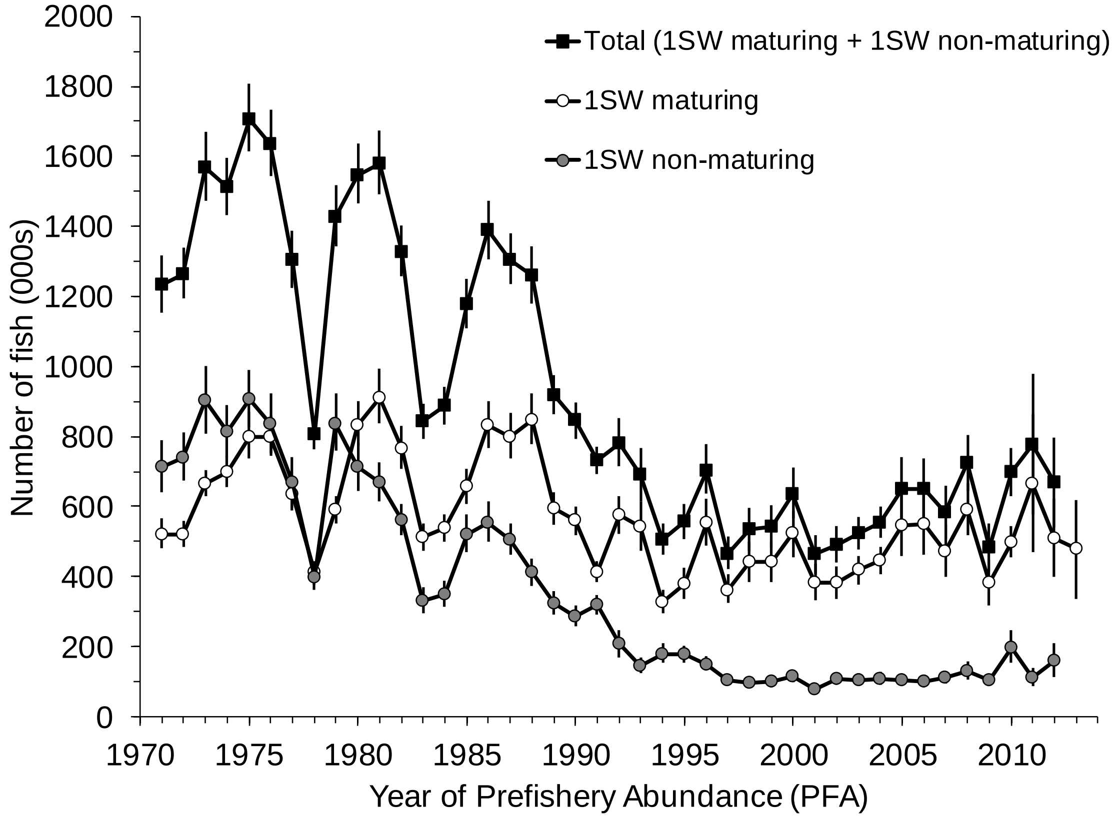


Figure 10.3.2 Estimates of PFA for 1SW maturing salmon, 1SW non-maturing salmon, and the total cohort of 1SW salmon based on the Monte Carlo simulations of the run–reconstruction model for NAC. Median and 95% CI interval ranges derived from Monte Carlo simulations are shown.

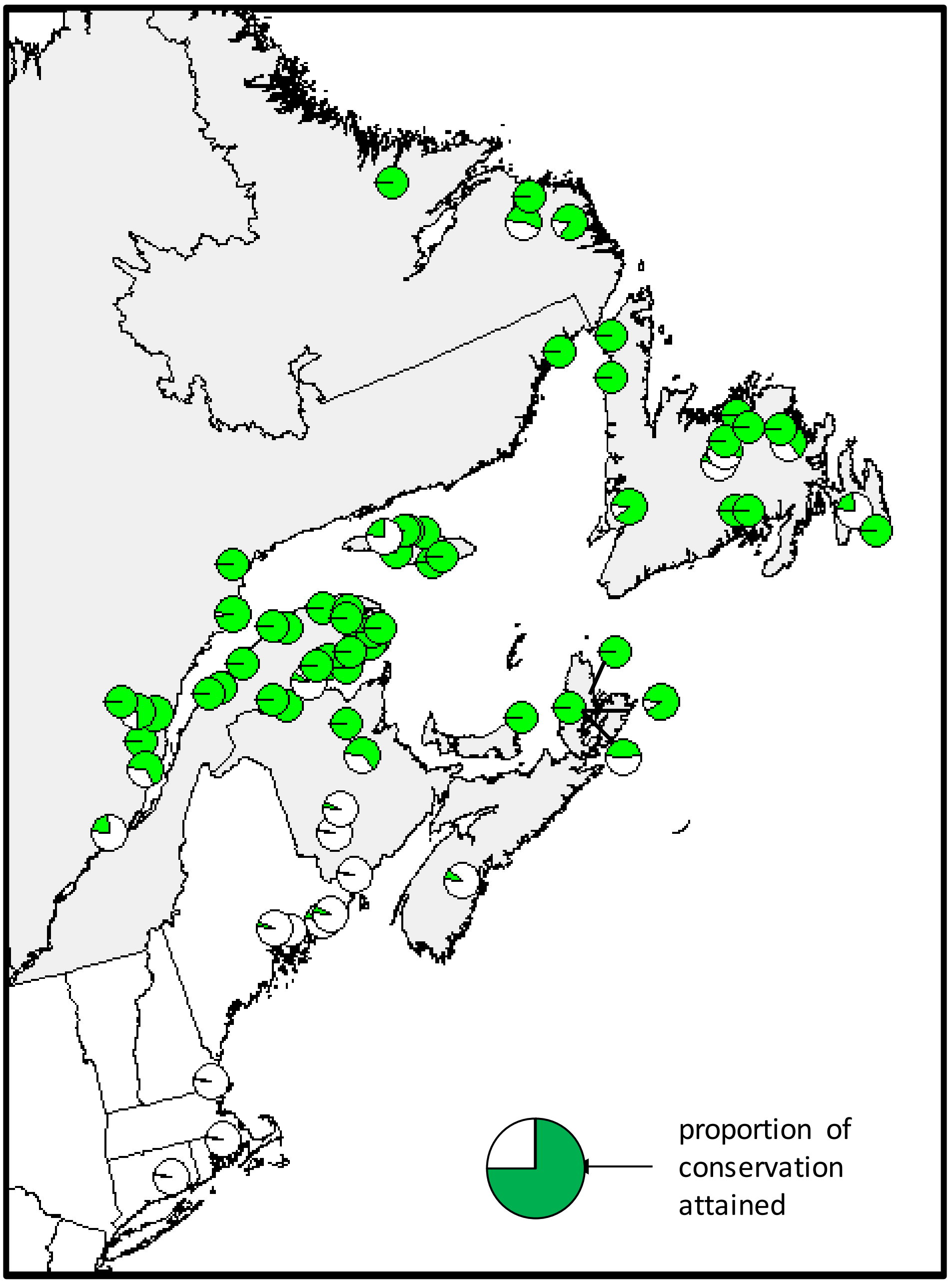


Figure 10.3.3 Proportion of the conservation egg requirement attained in assessed rivers of the North American Commission area in 2013.

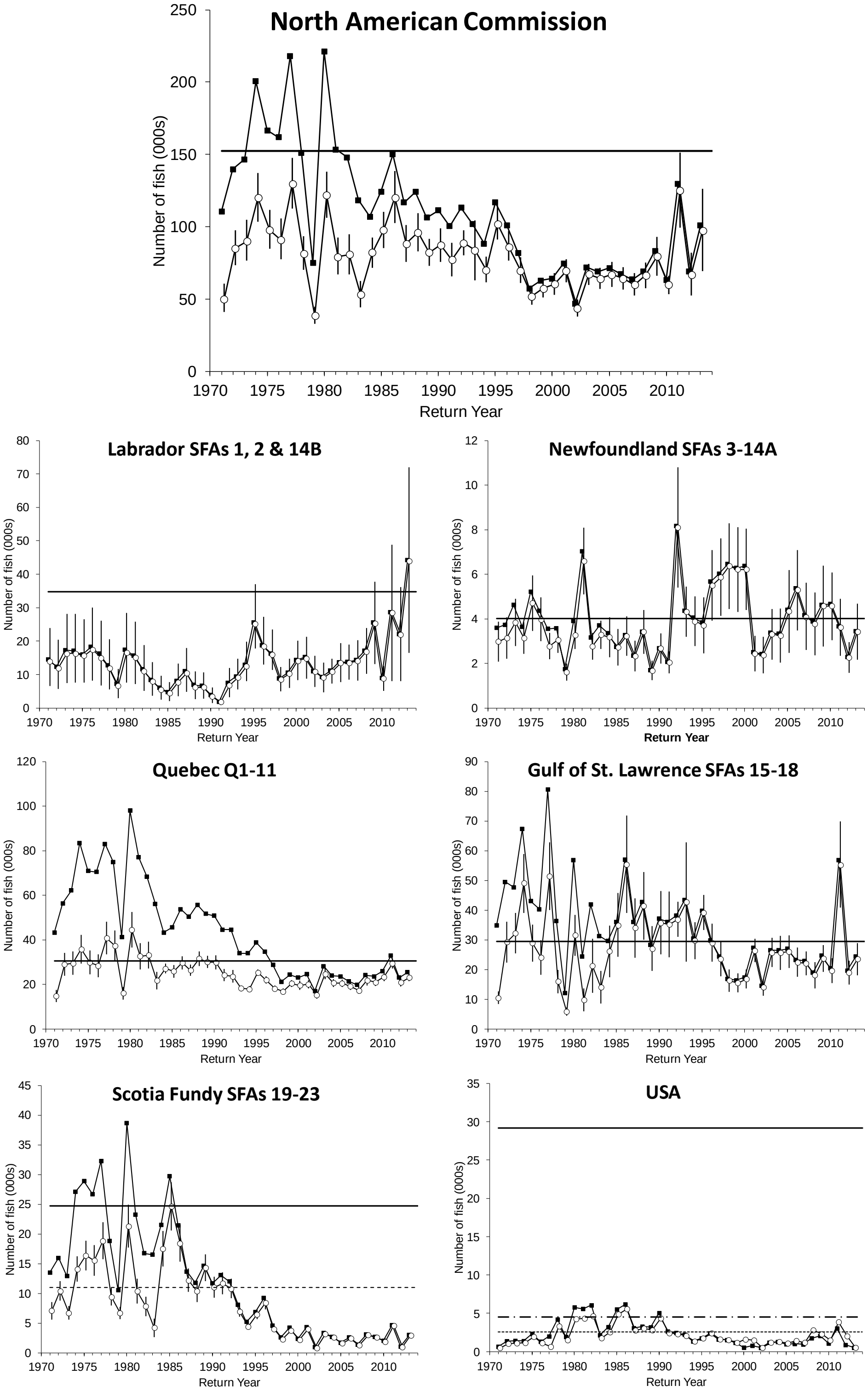


Figure 10.3.4 Comparison of the 2SW conservation limits (solid horizontal lines) and management objectives (dashed lines) to the estimated medians of 2SW returns (squares) and 2SW spawners (circles) in six geographic areas of North America. Returns and spawners for Scotia–Fundy do not include those from SFA 22 and a portion of SFA 23. For USA, estimated spawners may exceed the estimated returns due to adult stocking restoration efforts. For Scotia–Fundy, the dashed line is the current management objective of 10 976 2SW salmon spawners. For USA, the dash-dotted line is the proposed revised management objective of 4459 2SW salmon spawners.

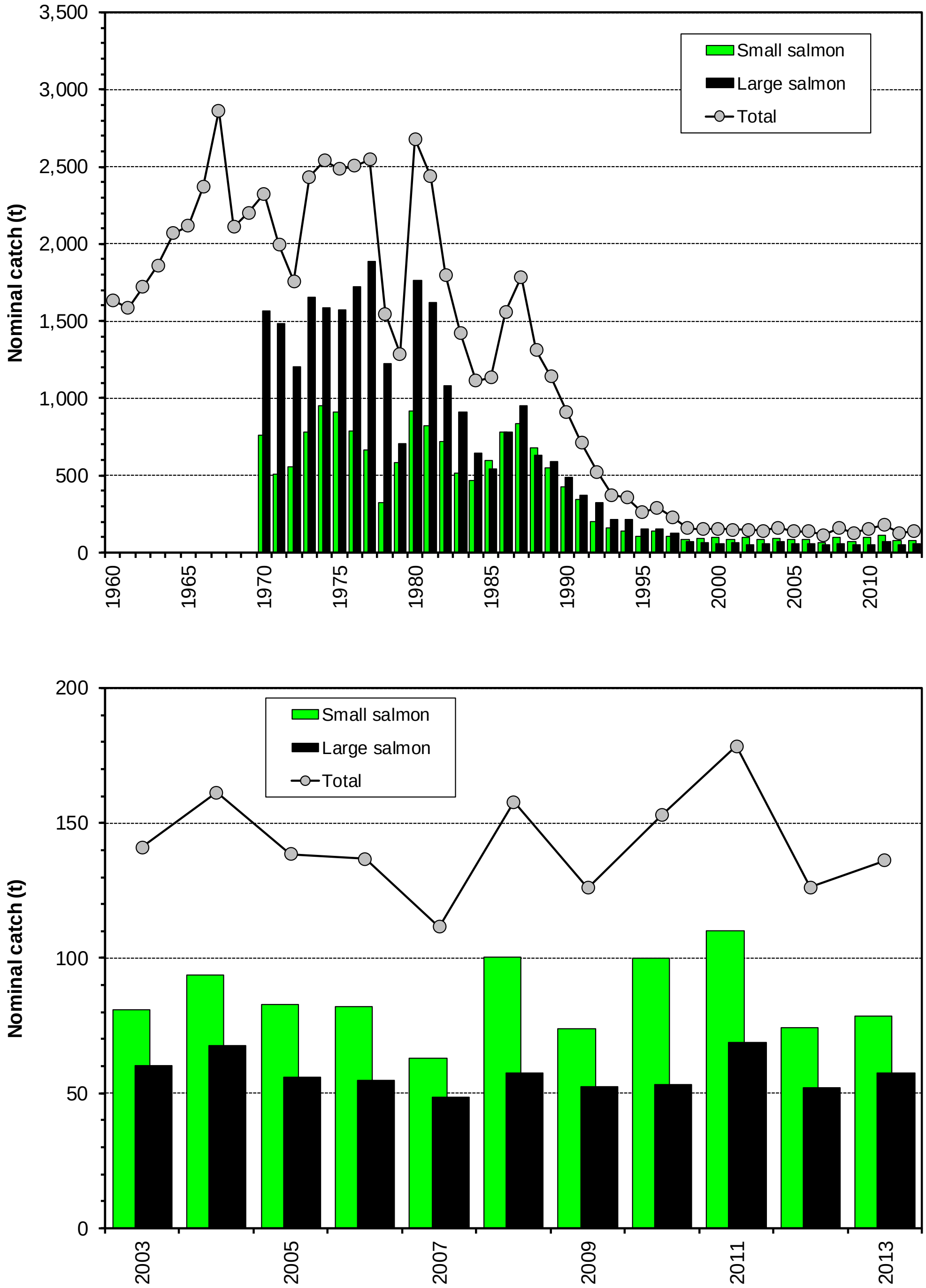


Figure 10.3.5 Harvest (t) of small salmon, large salmon, and combined for Canada, 1960 to 2013 (top panel) and 2003 to 2013 (bottom panel) by all users.

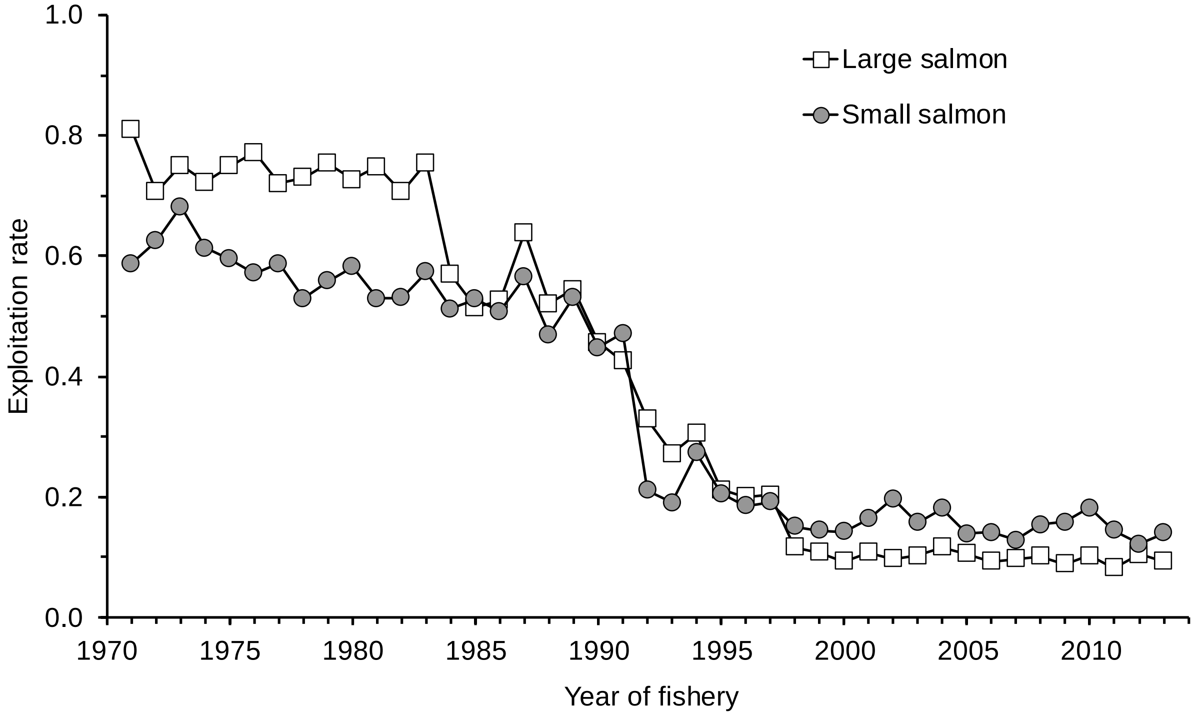


Figure 10.3.6 Exploitation rates in North America on the North American stock complex of small salmon (mostly 1SW) and large salmon (2SW, 3SW, and repeat spawners).

Table 10.3.1 Total reported nominal catch of salmon in homewaters by country (in tonnes, round fresh weight), 1980–2013 (2013 figures include provisional data).

	Canada			USA	St. P&M
Year	Total	Large	Small	Total	Total
1980	2 680	1 763	917	6	-
1981	2 437	1 619	818	6	-
1982	1 798	1 082	716	6	-
1983	1 424	911	513	1	3
1984	1 112	645	467	2	3
1985	1 133	540	593	2	3
1986	1 559	779	780	2	3
1987	1 784	951	833	1	2
1988	1 310	633	677	1	2
1989	1 139	590	549	2	2
1990	911	486	425	2	2
1991	711	370	341	1	1
1992	522	323	199	1	2
1993	373	214	159	1	3
1994	355	216	139	0	3
1995	260	153	107	0	1
1996	292	154	138	0	2
1997	229	126	103	0	2
1998	157	70	87	0	2
1999	152	64	88	0	2
2000	153	58	95	0	2
2001	148	61	86	0	2
2002	148	49	99	0	2
2003	141	60	81	0	3
2004	161	68	94	0	3
2005	139	56	83	0	3
2006	137	55	82	0	3
2007	112	49	63	0	2
2008	157	57	100	0	4
2009	126	52	74	0	3
2010	153	53	100	0	3
2011	179	69	110	0	4
2012	126	52	74	0	1
2013	136	58	79	0	5

ECOREGION **North Atlantic**

STOCK **Atlantic salmon at West Greenland**

Advice for 2014

The previous advice provided by ICES (2012) indicated that there were no mixed-stock fishery catch options at West Greenland in the years 2012–2014. The NASCO Framework of Indicators for the West Greenland fishery did not indicate the need for a revised analysis of catch options this year and, therefore, no new management advice for 2014 is provided. This year's assessment of the stock complexes contributing to the West Greenland fishery confirms that advice.

Stock status

For West Greenland, the stock status of 1SW non-maturing salmon (destined to mature as either 2SW or 3SW salmon) from North America and the Southern NEAC area are relevant.

In 2013, 2SW spawner estimates in all regions of North America with the exception of Labrador were below conservation limits (CLs) and therefore suffering reduced reproductive capacity. For Labrador, the median estimate of the 2SW spawners was above the CL for the first time in the assessment time-series beginning in 1971, although stocks were considered to be at risk of suffering reduced reproductive capacity. Estimates of pre-fishery abundance (PFA) suggest continued low abundance of North American adult salmon. Recruitment patterns of non-maturing 1SW recruits (PFA) for Southern NEAC show a declining trend over time, since the early 1970s. This stock was at full reproductive capacity, prior to the commencement of distant water fisheries, until 1997. Thereafter, the stock has been close to the spawner escapement reserve and at risk of suffering reduced reproductive capacity in about half of the assessment years, including the latest year. Overall, in North American and European areas, the status of stocks contributing to the West Greenland fishery is among the lowest recorded and, as a result, the abundance of salmon within the West Greenland area is thought to be very low compared to historical levels. This is broadly consistent with the general pattern of decline in marine survival in most monitored stocks in the area.

Despite increasingly more restrictive fishery management in recent decades, returns in these regions have remained near historical lows and many populations are currently threatened with extirpation. The continued low abundance of salmon stocks across North America and in the Northeast Atlantic thus further strengthens the conclusions that factors other than fisheries are constraining production.

Management plans

The North Atlantic Salmon Conservation Organization (NASCO) has adopted an Action Plan for Application of the Precautionary Approach (NASCO, 1999) which stipulates that management measures should be aimed at maintaining all stocks above their conservation limits by the use of management targets. NASCO has adopted the region-specific CLs as limit reference points (S_{lim}); having populations fall below these limits should be avoided with high probability. Within the agreed management plan, a simultaneous risk level of 75% (i.e. a 75% probability of all regions simultaneously achieving the management objective) has been agreed for the provision of catch advice on the stock complexes exploited at West Greenland (non-maturing 1SW fish from North America and Southern NEAC). The management objectives are to meet the 2SW CLs for the four northern areas of NAC (Labrador, Newfoundland, Québec, and Gulf), to achieve a 25% increase in returns of 2SW salmon from the average returns in 1992–1996 for the Scotia–Fundy and USA regions, and to meet the MSW Southern NEAC CL. A revised management objective has been proposed this year in respect of the USA, which is more in line with recovery criteria under the US Endangered Species Act. This would increase the management objective for the USA from 2548 to 4549 fish. The implications of this change for the provision of catch advice at West Greenland are evaluated in Section 10.1.12.

Biology

Atlantic salmon (*Salmo salar*) is an anadromous species found in rivers of countries bordering the North Atlantic. In the Northeast Atlantic area their current distribution extends from northern Portugal to the Pechora River in Northwest Russia and Iceland. In the Northwest Atlantic they range from the Connecticut River in USA to the Leaf River in Québec, Canada. Juveniles emigrate to the ocean at ages one to eight years (dependent on latitude) and generally return after one or two years at sea. Long-distance migrations to ocean feeding grounds take place with adult salmon from both the North American and the Northeast Atlantic stocks migrating to West Greenland (Figure 10.4.1) to feed on abundant prey during their second summer and autumn at sea.

Environmental influence on the stock

Environmental conditions in both freshwater and marine environments have a marked effect on the status of salmon stocks. Across the North Atlantic, a range of problems in the freshwater environment play a significant role in explaining the poor status of stocks. In many cases, factors such as river damming and habitat deterioration have had a devastating effect on freshwater environmental conditions. In the marine environment, return rates of adult salmon have declined through the 1980s and are now at the lowest levels in the time-series for some stocks, even after closure of marine fisheries. Climatic factors modifying ecosystem conditions are considered to be important contributory factors to lower productivity, which is expressed almost entirely in terms of lower marine survival.

The fisheries

Catches of Atlantic salmon at West Greenland increased through the 1960s, reaching a peak reported harvest rate of approximately 2700 t in 1971, and then decreased until the closure of the commercial fishery for export in 1998. However, the subsistence fishery has been increasing in recent years (Table 10.4.1). From 2002 to 2011, licensed fishers were allowed to sell salmon to local markets only. From 2012, under a new internal quota, licensed fishers were also allowed to land to factories, although the export ban persisted and the landed salmon could only be sold within Greenland. This internal quota was set unilaterally by the Government of Greenland at 35 t, for the factory landings only. A total catch of 47 t of salmon was reported for the 2013 fishery compared to 33 t for the 2012 fishery, an increase of 42%. As in 2012, the highest reported landings (18 t) occurred in NAFO Division 1C; the total catch reported in this division was the highest reported since 1996 (Table 10.4.2). Of the total catch, 7.9 t was reported as commercial, 13.4 t for private consumption, and 25.6 t as factory landings (Table 10.4.3). In total, 97% of the landings (45.6 t) came from licensed fishers.

In total, 82% of the salmon sampled at West Greenland in 2013 were of North American origin and 18% were determined to be of European origin (Figure 10.4.2); the proportion of North American origin fish in the fishery has remained high since the mid-1990s. The 1SW age group dominated the catch at >95% (Table 10.4.4). Approximately 11 500 (~38.9 t) North American origin fish and approximately 2700 (~8.8 t) European origin fish were harvested in 2013. These totals remain among the lowest in the time-series from the early 1970s, although they are the highest in the last decade (Figure 10.4.3).

Effects of the fisheries on the ecosystem

The current salmon fishery employs near-shore surface gillnets. There is no information on bycatch of other species with this gear. The fisheries probably have no, or only minor, influence on the marine ecosystem.

Quality considerations

Uncertainties in input variables to the stock status and stock forecast models are incorporated in the assessment. Catch reporting is considered to be incomplete.

Scientific basis

Assessment type	Run–reconstruction models and Bayesian forecasts, taking into account uncertainties in the data.
Input data	Nominal catches (by sea-age class) for commercial and recreational fisheries. Estimates of unreported/illegal catches. Estimates of exploitation rates. Natural mortalities (from earlier assessments).
Discards and bycatch	No salmon discards in this fishery.
Indicators	Framework of Indicators used to indicate if a significant change has occurred in the status of stocks in intermediate years where multi-annual management advice applies.
Other information	Advice subject to annual review. Stock annex completed in 2014.
Working group report	Working Group on North Atlantic Salmon WGNAS (ICES, 2014).

ECOREGION **North Atlantic**

STOCK **Atlantic salmon at West Greenland**

Reference points

For the Southern NEAC non-maturing stock complex, the conservation limit (CL) is 275 348 salmon. For NAC, the CL expressed in 2SW salmon spawners totals 152 548 fish.

Outlook for 2014

No outlook is provided because the Framework of Indicators for the West Greenland fishery did not indicate the need for an updated forecast this year.

MSY approach

Atlantic salmon has characteristics of short-lived fish stocks; mature abundance is sensitive to annual recruitment because there are only a few age groups in the adult spawning stock. Incoming recruitment is often the main component of the fishable stock. For such fish stocks, the ICES MSY approach is aimed at achieving a target escapement (MSY $B_{escapement}$, the amount of biomass left to spawn). No catch should be allowed unless this escapement can be achieved. The escapement level should be set so there is a low risk of future recruitment being impaired, similar to the basis for estimating B_{pa} in the precautionary approach. In short-lived stocks, where most of the annual surplus production stems from recruitment (not growth), MSY, $B_{escapement}$, and B_{pa} might be expected to be similar. CLs for North Atlantic salmon stock complexes have been defined by ICES as the level of stock (number of spawners) that will achieve long-term average maximum sustainable yield (MSY $B_{escapement}$).

ICES considers that to be consistent with the MSY and the precautionary approach, fisheries should only take place on salmon from rivers where stocks have been shown to be at full reproductive capacity. Due to the different status of individual stocks within the stock complex, mixed-stock fisheries present particular threats to stock status. Harvest at West Greenland cannot be targeted towards individual stocks, so weaker performing stocks are at risk.

Additional considerations

The management of a fishery should ideally be based upon the status of all stocks exploited in the fishery. Conservation would be best achieved if fisheries target stocks that have been shown to be at full reproductive capacity. Fisheries in estuaries and especially rivers are more likely to meet this requirement.

Data and methods

The international sampling programme for the fishery at West Greenland, agreed by the parties at NASCO, continued in 2013. The sampling was undertaken in three different communities, representing three different NAFO divisions. As in previous years, no sampling occurred in the fishery in East Greenland. The decentralized landings and broad geographic distribution of the fishery causes practical problems for the sampling programme. In total, 1156 individual salmon were inspected in 2013, representing approximately 9% by weight of the reported landings.

Uncertainties in assessments and forecasts

The fluctuations in the numbers of people reporting catches and the catches themselves in each of the NAFO divisions at West Greenland suggest that there are inconsistencies in the catch data and highlight the need for better data. In most years since 2002, in at least one of the divisions where international samplers were present, the sampling team observed more fish than were reported as being landed. When there is this type of discrepancy, the reported landings are adjusted according to the total weight of the fish identified as being landed at that location during the sampling period and these adjusted landings are carried forward for all future assessments (Table 10.4.5). In 2013, this occurred in two of the three sampled communities. The total discrepancy was approximately 0.7 t and the catch for assessment purposes was 47.7 t.

There is presently no quantitative approach for estimating the unreported catch, but the 2013 value is likely to have been at the same level as that proposed in recent years (10 t).

There have been some recent problems in the international sampling programme at West Greenland, with regards to access to fish in one of the NAFO divisions. This continued in 2013.

Comparison with previous assessment and catch options

The NASCO Framework of Indicators for the West Greenland fishery applied in January 2014 did not indicate the need for a revised analysis of catch options and no new management advice for 2014 is provided. The assessment was updated to include data up to 2013 and the status of stocks contributing to the West Greenland fishery was consistent with the previous year’s assessment.

Assessment and management area

The advice for the West Greenland fishery is based upon the Southern NEAC MSW stock complex and the North American 2SW complex.

Sources of information

ICES. 2012. Report of the Working Group on North Atlantic Salmon (WGNAS), 26 March–4 April 2012, Copenhagen, Denmark. ICES CM 2012/ACOM:09. 322 pp.

ICES. 2013a. Report of the Working Group on North Atlantic Salmon (WGNAS), 3–12 April 2013, Copenhagen, Denmark. ICES CM 2013/ACOM:09. 378 pp.

ICES. 2013b. North Atlantic salmon stocks. *In* Report of the ICES Advisory Committee, 2013. ICES Advice 2013, Book 10. 97 pp.

ICES. 2014. Report of the Working Group on North Atlantic Salmon (WGNAS), 19–28 March 2014, Copenhagen, Denmark. ICES CM 2014/ACOM:09. 107 pp.

NASCO 1998. North Atlantic Salmon Conservation Organization. Agreement on the adoption of a precautionary approach. Report of the 15th annual meeting of the Council. CNL(98)46. 4 pp.

NASCO 1999. North Atlantic Salmon Conservation Organization. Action plan for the application of the precautionary approach. CNL(99)48. 14 pp.

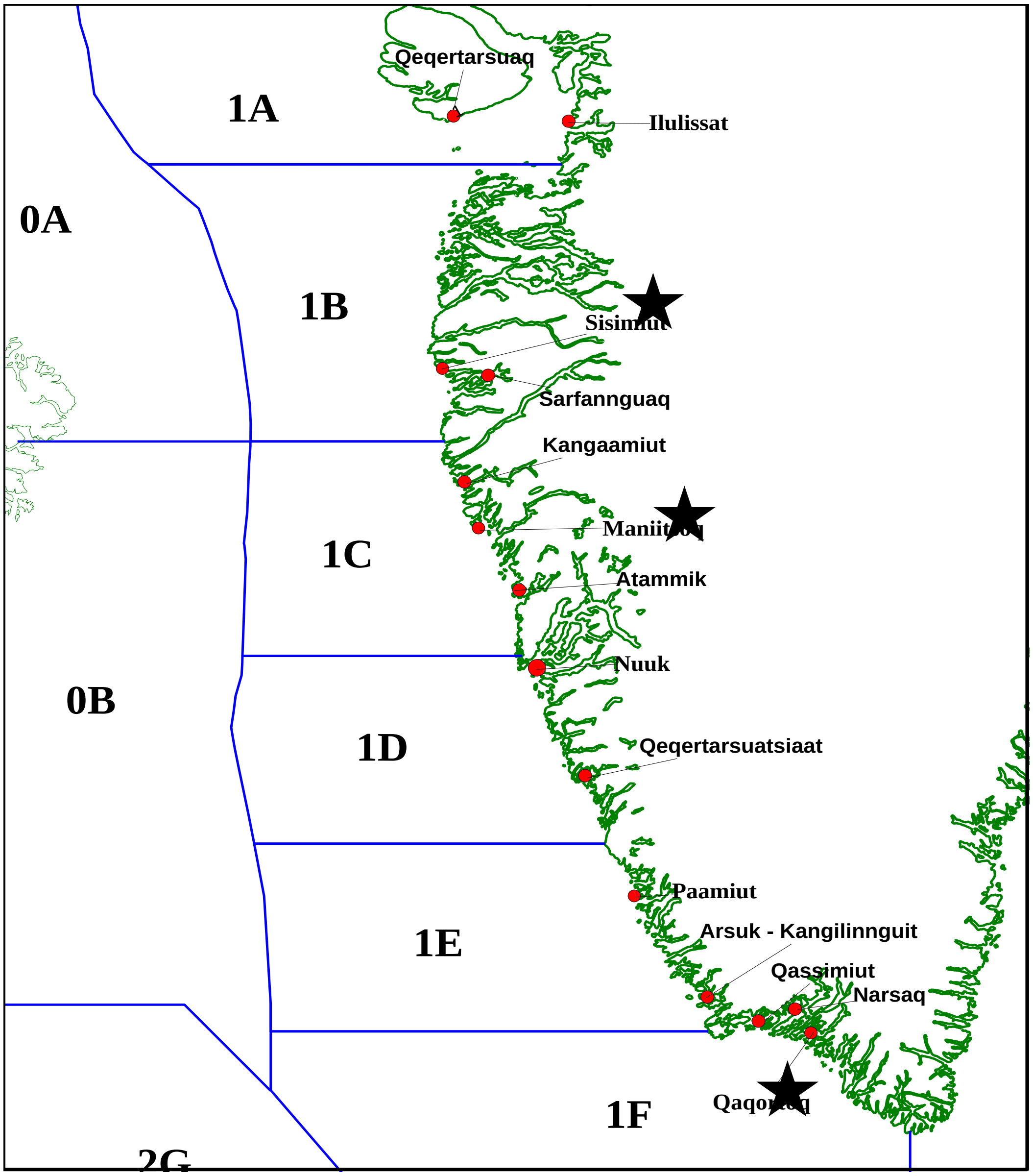


Figure 10.4.1 Location of NAFO divisions along the coast of West Greenland. Stars identify the communities where biological sampling occurred (Sisimiut, Maniitsoq, and Qaqortoq).

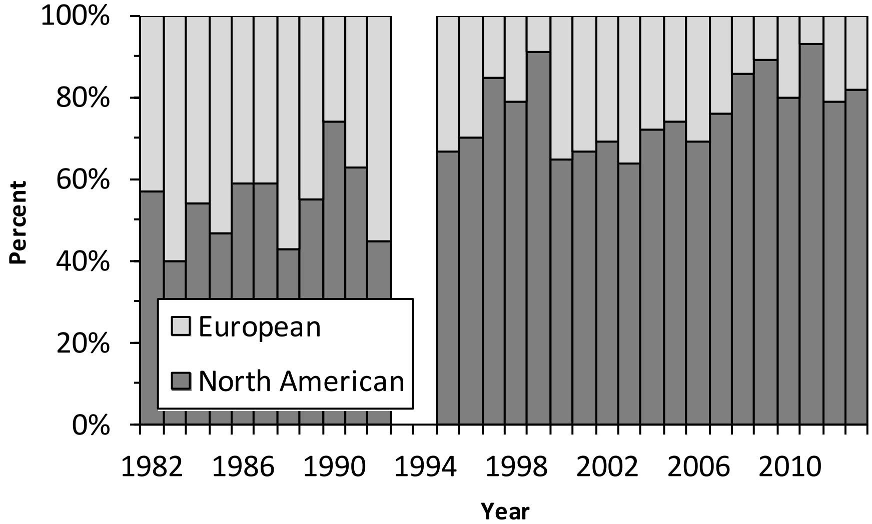


Figure 10.4.2 Percent of the sampled catch by continent of origin for the 1982 to 2013 Atlantic salmon West Greenland fishery.

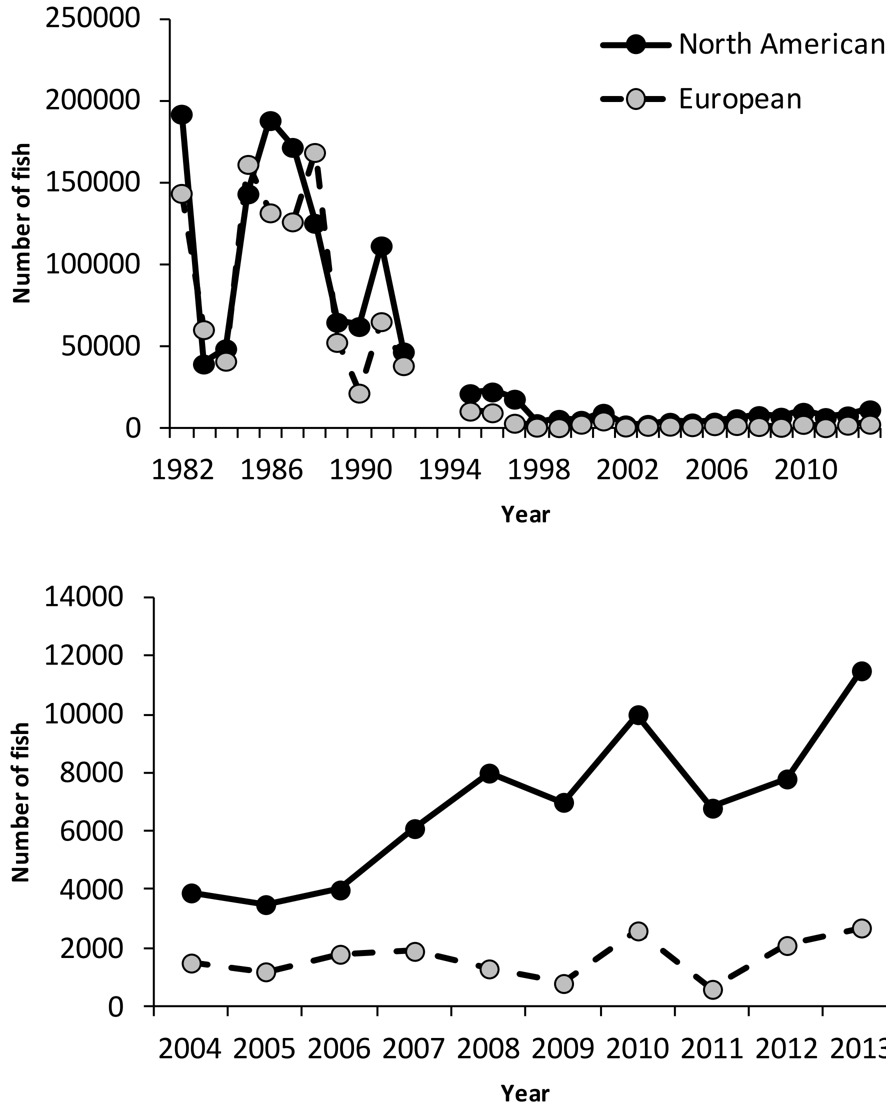


Figure 10.4.3 Number of North American and European Atlantic salmon caught at West Greenland from 1982 to 2013 (upper panel) and 2004 to 2013 (lower panel) based on NAFO division continent of origin weighted by catch (weight) in each division. Numbers are rounded to the nearest hundred fish. Unreported catch is not included in this assessment.

Table 10.4.1 Nominal catches of salmon at West Greenland since 1960 (metric tonnes round fresh weight) by participating nations. For Greenlandic vessels specifically, all catches up to 1968 were taken with set gillnets only and catches after 1968 were taken with set gillnets and drift nets. All non-Greenlandic vessel catches from 1969 to 1975 were taken with drift nets. The quota figures applied to Greenlandic vessels only.

YEAR	NORWAY	FAROES	SWEDEN	DENMARK	GREENLAND	TOTAL	QUOTA	COMMENTS
1960	-	-	-	-	60	60		
1961	-	-	-	-	127	127		
1962	-	-	-	-	244	244		
1963	-	-	-	-	466	466		
1964	-	-	-	-	1539	1539		
1965	-	36	-	-	825	858		Norwegian harvest figures were not available, but are known to be less than the Faroese catch.
1966	32	87	-	-	1251	1370		
1967	78	155	-	85	1283	1601		
1968	138	134	4	272	579	1127		
1969	250	215	30	355	1360	2210		
1970	270	259	8	358	1244	2139		Greenlandic total includes 7 t caught by longlines in the Labrador Sea.
1971	340	255	-	645	1449	2689	-	
1972	158	144	-	401	1410	2113	1100	
1973	200	171	-	385	1585	2341	1100	
1974	140	110	-	505	1162	1917	1191	
1975	217	260	-	382	1171	2030	1191	
1976	-	-	-	-	1175	1175	1191	
1977	-	-	-	-	1420	1420	1191	
1978	-	-	-	-	984	984	1191	
1979	-	-	-	-	1395	1395	1191	
1980	-	-	-	-	1194	1194	1191	
1981	-	-	-	-	1264	1264	1265	Quota set to a specific opening date for the fishery.
1982	-	-	-	-	1077	1077	1253	Quota set to a specific opening date for the fishery.
1983	-	-	-	-	310	310	1191	
1984	-	-	-	-	297	297	870	
1985	-	-	-	-	864	864	852	
1986	-	-	-	-	960	960	909	
1987	-	-	-	-	966	966	935	
1988	-	-	-	-	893	893	840	The quota for 1988–1990 was 2520 t with an opening date of August 1. Annual catches were not to exceed an annual average (840 t) by more than 10%. The quota was adjusted to 900 t in 1989 and 924 t in 1990 for later opening dates.

Year	Norway	Faroes	Sweden	Denmark	Greenland	Total	Quota	Comments
1989	-	-	-	-	337	337	900	
1990	-	-	-	-	274	274	924	
1991	-	-	-	-	472	472	840	
1992	-	-	-	-	237	237	258	Quota set by Greenland authorities.
1993	-	-	-	-			89	The fishery was suspended. NASCO adopted a new quota allocation model.
1994	-	-	-	-			137	The fishery was suspended and the quotas were bought out.
1995	-	-	-	-	83	83	77	Quota advised by NASCO.
1996	-	-	-	-	92	92	174	Quota set by Greenland authorities.
1997	-	-	-	-	58	58	57	Private (non-commercial) catches to be reported after 1997.
1998	-	-	-	-	11	11	20	Fishery restricted to catches used for internal consumption in Greenland.
1999	-	-	-	-	19	19	20	
2000	-	-	-	-	21	21	20	
2001	-	-	-	-	43	43	114	Final quota calculated according to the *ad hoc* management system.
2002	-	-	-	-	9	9	55	Quota bought out, quota represented the maximum allowable catch (no factory landing allowed), and higher catch figures based on sampling programme information are used for the assessments.
2003	-	-	-	-	9	9		Quota set to nil (no factory landing allowed), fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments.
2004	-	-	-	-	15	15		Same as previous year.
2005	-	-	-	-	15	15		Same as previous year.
2006	-	-	-	-	22	22		Quota set to nil (no factory landing allowed) and fishery restricted to catches used for internal consumption in Greenland.
2007	-	-	-	-	25	25		Quota set to nil (no factory landing allowed), fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments.
2008	-	-	-	-	26	26		Same as previous year.
2009	-	-	-	-	26	26		Same as previous year.

YEAR	NORWAY	FAROES	SWEDEN	DENMARK	GREENLAND	TOTAL	QUOTA	COMMENTS
2010	-	-	-	-	40	40		Same as previous year.
2011	-	-	-	-	28	28		Quota set to nil (no factory landing allowed) and fishery restricted to catches used for internal consumption in Greenland.
2012	-	-	-	-	33	33		Quota set to nil (unilateral decision made by Greenland to allow factory landing with a 35 t quota), fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments.
2013	-	-	-	-	47	47		Same as previous year.

Table 10.4.2 Distribution of nominal catches (metric tonnes) by Greenland vessels since 1960. NAFO divisions are indicated by 1A–1F. Since 2005, gutted weights have been reported and converted to total weight by a factor of 1.11.

YEAR	1A	1B	1C	1D	1E	1F	UNK.	WEST GREENLAND	EAST GREENLAND	TOTAL
1960							60	60		60
1961							127	127		127
1962							244	244		244
1963	1	172	180	68	45			466		466
1964	21	326	564	182	339	107		1 539		1 539
1965	19	234	274	86	202	10	36	861		861
1966	17	223	321	207	353	130	87	1 338		1 338
1967	2	205	382	228	336	125	236	1 514		1 514
1968	1	90	241	125	70	34	272	833		833
1969	41	396	245	234	370		867	2 153		2 153
1970	58	239	122	123	496	207	862	2 107		2 107
1971	144	355	724	302	410	159	560	2 654		2 654
1972	117	136	190	374	385	118	703	2 023		2 023
1973	220	271	262	440	619	329	200	2 341		2 341
1974	44	175	272	298	395	88	645	1 917		1 917
1975	147	468	212	224	352	185	442	2 030		2 030
1976	166	302	262	225	182	38		1 175		1 175
1977	201	393	336	207	237	46	-	1 420	6	1 426
1978	81	349	245	186	113	10	-	984	8	992
1979	120	343	524	213	164	31	-	1 395	+	1 395
1980	52	275	404	231	158	74	-	1 194	+	1 194
1981	105	403	348	203	153	32	20	1 264	+	1 264
1982	111	330	239	136	167	76	18	1 077	+	1 077
1983	14	77	93	41	55	30	-	310	+	310
1984	33	116	64	4	43	32	5	297	+	297
1985	85	124	198	207	147	103	-	864	7	871
1986	46	73	128	203	233	277	-	960	19	979
1987	48	114	229	205	261	109	-	966	+	966
1988	24	100	213	191	198	167	-	893	4	897
1989	9	28	81	73	75	71	-	337	-	337
1990	4	20	132	54	16	48	-	274	-	274
1991	12	36	120	38	108	158	-	472	4	476
1992	-	4	23	5	75	130	-	237	5	242
1993 [1]	-	-	-	-	-	-	-	-	-	-
1994 [1]	-	-	-	-	-	-	-	-	-	-
1995	+	10	28	17	22	5	-	83	2	85
1996	+	+	50	8	23	10	-	92	+	92
1997	1	5	15	4	16	17	-	58	1	59
1998	1	2	2	4	1	2	-	11	-	11
1999	+	2	3	9	2	2	-	19	+	19
2000	+	+	1	7	+	13	-	21	-	21
2001	+	1	4	5	3	28	-	43	-	43
2002	+	+	2	4	1	2	-	9	-	9
2003	1	+	2	1	1	5	-	9	-	9

2004	3	1	4	2	3	2	-	15	-	15
2005	1	3	2	1	3	5	-	15	-	15
2006	6	2	3	4	2	4	-	22	-	22
2007	2	5	6	4	5	2	-	25	-	25
2008	4.9	2.2	10.0	1.6	2.5	5.0	0	26.2	0	26.2
2009	0.2	6.2	7.1	3.0	4.3	4.8	0	25.6	0.8	26.3
2010	17.3	4.6	2.4	2.7	6.8	4.3	0	38.1	1.7	39.6
2011	1.8	3.7	5.3	8.0	4.0	4.6	0	27.4	0.1	27.5
2012	5.4	0.8	15.0	4.6	4.0	3.0	0	32.6	0.5	33.1
2013	3.1	2.4	17.9	13.4	6.4	3.8	0	47.0	0.0	47.0

[1] The fishery was suspended.

+ Small catches < 5 t.

- No catch.

Table 10.4.3 Reported landings (t) by landing category, the number of fishers reporting, and the total number of landing reports received for licensed and unlicensed fishers in 2010–2013.

NAFO /ICES	Licensed	No. of Fishers	No. of Reports	Comm	Private	Factory	Total	Licensed	No. of Fishers	No. of Reports	Comm	Private	Factory	Total
2013								**2012**						
1A	NO	10	32	0.3	0.0		0.3	NO	8	25		0.6		0.6
1A	YES	18	94	1.2	1.6		2.8	YES	27	142	1.3	3.5		4.8
1A	**TOTAL**	**28**	**126**	**1.5**	**1.6**		**3.1**	**TOTAL**	**35**	**167**	**1.3**	**4.1**		**5.4**
1B	NO	2	5	0.2			0.2	NO	3	3		0.2		0.2
1B	YES	6	14	1.3	0.9		2.2	YES	6	19	0.1	0.5		0.5
1B	**TOTAL**	**8**	**19**	**1.4**	**0.9**		**2.4**	**TOTAL**	**9**	**22**	**0.1**	**0.7**		**0.8**
1C	NO							NO	2	6		0.3		0.3
1C	YES	21	205	2.2	3.5	12.3	18.0	YES	30	172	1.8	0.8	12.1	14.7
1C	**TOTAL**	**21**	**205**	**2.2**	**3.5**	**12.3**	**18.0**	**TOTAL**	**32**	**178**	**1.8**	**1.2**	**12.1**	**15.0**
1D	NO	10	23	0.4	0.0		0.5	NO	5	15	0.0	0.4		0.4
1D	YES	9	112	0.1	4.8	8.0	12.9	YES	3	23	1.4	1.2	1.6	4.2
1D	**TOTAL**	**19**	**135**	**0.5**	**4.9**	**8.0**	**13.4**	**TOTAL**	**8**	**38**	**1.4**	**1.6**	**1.6**	**4.6**
1E	NO	1	1	0.1			0.1	NO	13	22		1.3		1.3
1E	YES	6	41	0.8	0.2	5.3	6.4	YES	3	45	0.8	1.9		2.7
1E	**TOTAL**	**7**	**42**	**0.9**	**0.2**	**5.3**	**6.4**	**TOTAL**	**16**	**67**	**0.8**	**3.2**		**4.0**
1F	NO	5	10	0.3			0.3	NO	6	17		0.7		0.7
1F	YES	6	15	1.0	2.4		3.4	YES	10	40	0.1	2.2		2.3
1F	**TOTAL**	**11**	**25**	**1.4**	**2.4**		**3.8**	**TOTAL**	**16**	**57**	**0.1**	**2.8**		**3.0**
XIV	NO	1	1	0.0			0.0	NO	6	24		0.5		0.5
XIV	YES							YES	0	0				
XIV	**TOTAL**	**1**	**1**	**0.0**			**0.0**	**TOTAL**	**6**	**24**		**0.5**		**0.5**
ALL	NO	29	72	1.3	0.1		1.4	NO	43	112	0.0	4.1		4.1
ALL	YES	66	481	6.6	13.4	25.6	45.6	YES	79	441	5.5	9.9	13.7	29.1
ALL	**TOTAL**	**95**	**553**	**7.9**	**13.4**	**25.6**	**47.0**	**TOTAL**	**122**	**553**	**5.5**	**14.1**	**13.7**	**33.2**

NAFO /ICES	Licensed	No. of Fishers	No. of Reports	Comm	Private	Factory	Total
<u>2011</u>							
1A	NO	4	4		0.2		0.2
1A	YES	21	54	0.9	0.8		1.7
1A	**TOTAL**	**25**	**58**	**0.9**	**1.0**		**1.9**
1B	NO	3	3		0.2		0.2
1B	YES	6	27	2.8	0.6		3.5
1B	**TOTAL**	**9**	**30**	**2.8**	**0.8**		**3.7**
1C	NO	6	6		0.7		0.7
1C	YES	14	50	3.2	1.4		4.6
1C	**TOTAL**	**20**	**56**	**3.2**	**2.1**		**5.3**
1D	NO	9	9		0.7		0.7
1D	YES	6	86	7.1	0.2		7.3
1D	**TOTAL**	**15**	**95**	**7.1**	**0.9**		**8.0**
1E	NO	16	29		1.8		1.8
1E	YES	4	65	1.1	1.1		2.2
1E	**TOTAL**	**20**	**94**	**1.1**	**2.9**		**4.0**
1F	NO	13	19		2.5		2.5
1F	YES	10	31	1.5	0.7		2.1
1F	**TOTAL**	**23**	**50**	**1.5**	**3.1**		**4.6**
XIV	NO	5	11		0.1		0.1
XIV	YES	0	0				
XIV	**TOTAL**	**5**	**11**		**0.1**		**0.1**
ALL	NO	56	81		6.1		6.1
ALL	YES	61	313	16.5	4.9		21.4
ALL	**TOTAL**	**117**	**394**	**16.5**	**11.0**		**27.5**

Licensed	No. of Fishers	No. of Reports	Comm	Private	Factory	Total
<u>2010</u>						
YES	54	93	4.6	8.2		12.7
NO	32	39		4.5		4.5
TOTAL	**86**	**132**	**4.6**	**12.7**		**17.3**
YES	14	28	1.5	2.8		4.4
NO	3	3	0.0	0.2		0.2
TOTAL	**17**	**31**	**1.6**	**3.0**		**4.6**
YES	9	13	1.1	0.5		1.6
NO	10	15		0.7		0.7
TOTAL	**19**	**28**	**1.1**	**1.3**		**2.4**
YES	7	16	1.5	0.6		2.2
NO	9	16	0.1	0.5		0.6
TOTAL	**16**	**32**	**1.6**	**1.1**		**2.7**
YES	10	46	1.7	1.4		3.1
NO	20	32		3.7		3.7
TOTAL	**30**	**78**	**1.7**	**5.1**		**6.8**
YES	16	29	1.9	1.5		3.4
NO	11	19		0.9		0.9
TOTAL	**27**	**48**	**1.9**	**2.3**		**4.3**
YES	0	0				
NO	13	40		1.7		1.7
TOTAL	**13**	**40**		**1.7**		**1.7**
YES	110	225	12.3	15.0		27.3
NO	98	164	0.1	12.3		12.4
TOTAL	**208**	**389**	**12.4**	**27.3**		**39.7**

Table 10.4.4 Summary of biological characteristics of catches at West Greenland in 2013.

River age distribution (%) by origin (NA – North America, E – Europe)

	1	2	3	4	5	6	7	8
NA	0.1	32.6	37.3	20.8	8.6	0.6	0	0
E	4.5	68.2	24.4	2.5	0	0	0	0

Length and weight by origin and sea age

	1 SW		2 SW		Previous spawners		All sea ages	
	Fork length (cm)	Whole weight (kg)	Fork length (cm)	Whole weight (kg)	Fork length (cm)	Whole weight (kg)	Fork length (cm)	Whole weight (kg)
NA	66.2	3.33	81.0	6.43	69.9	3.64	na	3.39
E	64.6	3.16	72.8	4.51	73.6	5.38	na	3.20

Continent of origin (%)

North America	Europe
81.6	18.4

Sea age composition (%) by continent of origin:

North America (NA) and Europe (E)

	1SW	2SW	Previous Spawners
NA	94.9	1.4	3.7
E	96.6	2.4	1.0

Table 10.4.5 Reported landings (kg) for the West Greenland Atlantic salmon fishery from 2002 by NAFO division and the division-specific adjusted landings where the sampling teams observed more fish landed than were reported. Adjusted landings were not calculated for 2006 and 2011 as the sampling teams did not observe more fish than were reported in those years.

YEAR		1A	1B	1C	1D	1E	1F	TOTAL
2002	Reported	14	78	2 100	3 752	1 417	1 661	9 022
	Adjusted						2 408	9 769
2003	Reported	619	17	1 621	648	1 274	4 516	8 694
	Adjusted			1 782	2 709		5 912	12 312
2004	Reported	3 476	611	3 516	2 433	2 609	2 068	14 712
	Adjusted				4 929			17 209
2005	Reported	1 294	3 120	2 240	756	2 937	4 956	15 303
	Adjusted				2 730			17 276
2006	Reported	5 427	2 611	3 424	4 731	2 636	4 192	23 021
	Adjusted							
2007	Reported	2 019	5 089	6 148	4 470	4 828	2 093	24 647
	Adjusted						2 252	24 806
2008	Reported	4 882	2 210	10 024	1 595	2 457	4 979	26 147
	Adjusted				3 577		5 478	28 627
2009	Reported	195	6 151	7 090	2 988	4 296	4 777	25 496
	Adjusted				5 466			27 975
2010	Reported	17 263	4 558	2 363	2 747	6 766	4 252	37 949
	Adjusted		4 824		6 566		5 274	43 056
2011	Reported	1 858	3 662	5 274	7 977	4 021	4 613	27 407
	Adjusted							
2012	Reported	5 353	784	14 991	4 564	3 993	2 951	32 636
	Adjusted		2 001				3 694	34 596
2013	Reported	3 052	2 358	17 950	13 356	6 442	3 774	46 933
	Adjusted		2 461				4 408	47 669